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Ashland Resource Area
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APPLEGATE-STAR/BOAZ Watershed Analysis

Version 1.3

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Applegate-Star/Boaz Watershed Analysis

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Bureau of Land Management, Medford District
Ashland Resource Area

September 1998

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EXECUTIVE SUMMARY

Introduction

Watershed analysis is the primary tool for generating information to implement ecosystem management as directed in the Northwest Forest Plan and the Medford District Resource Management Plan. The Applegate-Star/Boaz Watershed Analysis documents conditions and interrelationships of ecosystem components for the Applegate-Star/Boaz Watershed Analysis Area. The analysis focuses on issues and key questions that are most relevant to the management questions, human values, and resource conditions within the watershed. Management objectives and recommendations for federal lands are prioritized based on conclusions reached through the analysis. The watershed analysis formulates an overall landscape design and recognizes the inventory, monitoring, and research needs for the watershed.

The Applegate-Star/Boaz Watershed Analysis was prepared by an interdisciplinary team of resource professionals and specialists from the Bureau of Land Management (BLM) Ashland Resource Area and Medford District Staff. The watershed analysis team followed the six-step process outlined in the *Ecosystem Analysis at the Watershed Scale, Federal Guide for Watershed Analysis, version 2.2*. The six steps or sections included in the Applegate-Star/Boaz Watershed Analysis are: 1) characterization, 2) issues and key questions, 3) current conditions, 4) reference conditions, 5) syntheses and interpretation of information, and 6) recommendations.

The analysis was completed by the team in December 1996. Editing of the document was put on hold until 1998 due to other priority work. Information considered critical to the analysis was updated in 1998, but the majority of the analysis is based on data from 1996 or previous years.

The Applegate-Star/Boaz Watershed Analysis addresses the entire analysis area and is based on existing information and recent data collection. Much of the information found in this watershed analysis comes from documents prepared for the Applegate River Subbasin. Where resource information is missing, a data gap is identified. The watershed analysis process is iterative and new information will be used to supplement future iterations of the analysis.

Public participation for the Applegate-Star/Boaz Watershed Analysis built upon previous public involvement efforts. A letter was sent to local residents, local and regional interest groups, and to most local, state, and federal agencies in Jackson and Josephine counties. The letter provided an opportunity to return written comments and an invitation to a field trip for review of the watershed. Specialists met with interested members of the public and reviewed the watershed area in the field. The objective of the letter and the field trip was to solicit thoughts and ideas and to share preliminary issues and key questions for the watershed analysis.

Watershed Characterization

The Applegate-Star/Boaz Watershed Analysis Area is a 28-square mile (17,651 acres) area within the Applegate River Subbasin. The Applegate River is one of seven subbasins within the Rogue River Basin in southwestern Oregon. The Applegate-Star/Boaz Watershed Analysis Area lies within the Siskiyou Mountains of the Klamath Geologic Province and extends from the mouth of the Little Applegate River to just upstream of Boaz Gulch.

Land ownership within the Applegate-Star/Boaz Analysis Area is divided between the Bureau of Land Management (14,811 acres), U.S. Forest Service (544 acres), and private (2,296 acres). Federal land use allocations include Riparian Reserves and the Applegate Adaptive Management Area.

The Applegate Valley is one of the driest and warmest areas west of the Cascade Mountains. The Applegate-Star/Boaz Watershed Analysis Area is characterized by a frequent, low intensity fire regime.

The terrain within the Applegate-Star/Boaz Analysis Area consists of steep hillsides and flat valley bottoms. Overall, soils within the watershed are stable and erosion rates are relatively low. However, there are some erosion-prone, steep, gravel-surfaced slopes and granitic areas.

Endemic vegetation in the Applegate-Star/Boaz Analysis Area is a result of climate fluctuations and the unique geology of the area. Plant series identified for BLM-managed lands within the watershed include Douglas-fir, ponderosa pine, and white oak. There are 8 special status vascular plants known to occur within the analysis area and 12 survey and manage plants.

The analysis area also contains habitat for the Siskiyou Mountains salamander and Critical Habitat for the northern spotted owl. The Applegate-Star/Boaz Watershed Analysis Area provides spawning and rearing habitat to several anadromous and resident fish species, including coho salmon and steelhead.

Human Uses

Prior to the nineteenth century, native people lived in villages along the Applegate River and its tributaries. Those who lived in the area managed the land to enhance resources that were of value to them; most of these resources were meant for local consumption, and some may have been used in trade. Native land management fostered a landscape with a diversity of plants and animals and an abundance of staple crops. Selective use of fire was important, especially in the valleys and foothills. This pattern of interaction ended in the middle of the nineteenth century. Early trappers, miners, and settlers brought many changes to the land; the hydrology, vegetation patterns, topography, and native species (plant and animal) have all been affected by numerous actions including agriculture, ranching, logging, road building, fire suppression, and settlement.

Today much of the analysis area is under federal land management. Federal policies have an

important effect on these lands and reflect national political and economic goals. However, biological health of the land and sustainable economic practices require land managers to take greater account of specific local conditions and local community knowledge. This has resulted in the federal government's current focus on ecosystem management and the implementation of adaptive management practices. The adaptive management strategy allows the flexibility necessary to adapt national programs and goals to local conditions and concerns.

Recreational use of the area takes place year-round. Recreational use includes dispersed camping, as well as activities such as hunting, fishing, mushroom picking, sight seeing, and mining. There are no developed recreation sites in the analysis area.

Timber harvest on federal land other than salvage logging virtually halted in 1991 when the northern spotted owl was listed as a threatened species under the Endangered Species Act. Logging has resumed under the 1994 Northwest Forest Plan using different types of harvest methods, such as commercial thinning, density management, and mortality salvage.

The analysis area contains portions of three BLM-administered grazing allotments. Grazing has decreased on both public and private lands due to changing demand, increased settlement, and changing land-use.

Several Native American sites and isolated finds are recorded within the analysis area; the most notable site is the site at USFS Star Ranger Station. There are also four historic sites recorded that related to mining activities. Unauthorized collecting and digging is a significant problem on public lands and is severely affecting the quality of these archaeological sites.

The Confederated Tribes of Siletz and the Confederated Tribes of Grande Ronde are the federally recognized tribes with closest ties to most of the watershed. There are no reserved treaty or tribal rights in the analysis area.

Terrestrial Ecosystem

The vegetation of the Applegate-Star/Boaz Watershed Analysis Area is dominated by forest land and shrubland; grasslands and oak woodlands were more prevalent in the past. Historically, forest land that consisted of large diameter Douglas-fir, pine and cedar stands with few stems per acre has changed to smaller diameter, densely stocked Douglas-fir stands, which are closed-canopy, single layered and in the mid-seral stage with many stems per acre. Individual trees are low in vigor and without density management, stand mortality can be expected especially on pine sites.

Fire is a primary disturbance factor within the watershed. Historically, vegetation composition and density was regulated by frequent, low intensity fire. This fire regime favored and maintained fire adapted species and low vegetation densities. Since fire suppression has become effective on a large scale, the vegetation has undergone many changes as fire is excluded. Native fire adapted species are being replaced by non-fire adapted species, including some noxious weeds. Vegetation densities have increased dramatically. These

changes have caused a shift in the intensity and effects of wildfires when they occur. High intensity wildfire has become more common and costly due to the increased damages to human development and the ecosystem. Current trends in silvicultural and prescribed fire practices are focusing on restoring and maintaining vegetative communities to a more fire resilient, native vegetation condition.

Wildlife habitat, vegetation, and topography are diverse throughout the elevation ranges of the analysis area. Current habitat conditions are a result of human activities, such as logging, agriculture, and fire suppression. Loss or modification of habitat is probably most pronounced in the mature/old-growth condition class, and wildlife species associated with this habitat have likely been the most affected. These same activities have decreased the habitat of several species that have special protection status and the northern spotted owl (a threatened/endangered species). Also, special status plant species populations have been reduced or eliminated due to timber harvesting, road building, and conversion of native plant communities to domestic and agricultural use.

Aquatic Ecosystem

The streamflow regime reflects human influences that have occurred since Euro-Americans arrived. Road construction, timber harvest, and fire suppression are the major factors having the potential to adversely affect the timing and magnitude of streamflows in Star Gulch. For the Applegate River corridor area, the Applegate Dam and water withdrawals have had the greatest impact on streamflows.

Channel conditions and sediment transport processes in the Applegate-Star/Boaz Watershed Analysis Area have changed since Euro-American settlers arrived in the 1830s primarily due to mining, road building, and removal of riparian vegetation. Historical mining confined channels, encouraged channel downcutting, destroyed riparian habitat and removed trees, which contributed to habitat degradation. Use of small dredges has minimal impact on habitat; however, it does loosen and displace the spawning gravels. Unsurfaced roads (road-related erosion) that parallel streams and road crossings also contribute fine sediments to streams and rivers. Fine sediments have a cumulative impact on water quality. Sedimentation effects on fish are substrate embeddedness, poor pool quality, reduced hiding cover, and damaged fish gills.

Lack of riparian vegetation and water withdrawals have contributed to high summer stream temperatures that can stress aquatic life in the analysis area. The portion of the Applegate River within the analysis area is designated by the State as water quality limited due to flow modification and temperature. Star Gulch from the mouth to 1918 Gulch is included on the 1998 draft list of water quality limited water bodies due to temperature. Protection of vegetation providing stream shade and recovery of riparian vegetation should bring about the reduction of stream temperatures in Star Gulch. Water temperatures are likely to maintain the same pattern in the Applegate River due to withdrawals, high width-to-depth ratio, and lack of riparian cover.

Riparian Reserves along intermittent, perennial nonfish-bearing and fish-bearing streams will help to provide a future long-term source of large woody material recruitment for streams on federal lands. There is a minimal amount of large woody material in the analysis area's Riparian Reserves.

In the Applegate River, the limiting factors for long-term sustainability of native fish and other aquatic species are high summer water temperatures, lack of side channels and edgewater rearing habitat (especially for coho salmon), lack of winter habitat, and flood refugia. In Star Gulch, the limiting habitat factors are the lack of and poor quality spawning, summer rearing, and winter habitat. Other limiting factors are high temperatures in the lower reaches, and difficult access from the Applegate River for migrating steelhead and lamprey.

Temperature, habitat modification, and sedimentation that affect water quality and limit factors for long-term sustainability of native fish and other aquatic species will continue to be high priority issues. Restoration projects (educational partnerships, research, and monitoring) to protect fisheries habitat and water quality are vitally important.

INTRODUCTION

Objective of the Watershed Analysis

The Applegate-Star/Boaz Watershed Analysis documents conditions and interrelationships of ecosystem components for the analysis area. It describes the dominant features and physical, biological, and social processes within the analysis area. The document compares prehistorical (before 1850) and historical (reference) conditions with current ecosystem conditions and discusses the development of current conditions and future trends. It also ranks management objectives and recommendations for federal lands as high, medium, or low priority, and directs development of a landscape plan for federal lands. This document is intended to guide subsequent project planning and decision making in the Applegate-Star/Boaz Watershed Analysis Area. This document is not a decision document under the National Environmental Policy Act (NEPA) and there is no action being implemented with this analysis. Site-specific analysis incorporating the NEPA process would occur prior to any project implementation.

How The Analysis Was Conducted

The Applegate-Star/Boaz Watershed Analysis was prepared by an interdisciplinary team of resource professionals and specialists from the Bureau of Land Management (BLM) Ashland Resource Area and Medford District Staff (see List of Preparers). The team also included a representative from the U.S. Fish and Wildlife Service, Brendan White. Group discussions identified linkages among resources and resulted in an integrated, synthesized report.

Guidelines used to direct the preparation of the Applegate-Star/Boaz Watershed Analysis included: the *Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl*, and *Standards and Guidelines for Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl* (USDA and USDI 1994a) (these two documents are combined into what is known as the Northwest Forest Plan), *Ecosystem Analysis at the Watershed Scale: Federal Guide for Watershed Analysis, Version 2.2* (USDA et al. 1995), and the *Medford District Watershed Analysis Guidelines* (USDI 1994a).

The Applegate-Star/Boaz Watershed Analysis is based on existing information and addresses the entire analysis area, although recommendations are only made for federal lands. Much of the information found in this analysis came from documents prepared for the Applegate River Subbasin: *Applegate Adaptive Management Area Ecosystem Health Assessment* (USDA and USDI 1994b); *Applegate River Watershed Assessment: Aquatic, Wildlife, and Special Plant Habitat* (USDA and USDI 1995); *Words into Action: A Community Assessment of the Applegate Valley* (Preister 1994); and *Applegate Watershed Assessment* (Applegate River Watershed Council 1994). Reference condition information was obtained primarily from *An Environmental History of the Little Applegate River Watershed* (LaLande 1995).

Where resource information is missing, a data gap is identified. Data gaps are prioritized and listed in a separate section; missing information will be acquired as funding permits. The analysis process is dynamic and the document will be revised as new information is obtained. Types of new information may include resource data collected at the project level and monitoring data. An updated version of this document will be issued when new data and information collected indicate important changes in watershed conditions or trends.

The analysis was completed by the team in December 1996, however, editing of the document was put on hold until 1998 due to other priority work. Information considered critical to the analysis was updated in 1998, but the majority of the analysis is based on data from 1996 or previous years.

Document Organization

The organization of this document follows the format described in the *Federal Guide for Watershed Analysis, Version 2.2* (USDA et al. 1995). The Issues and Key Questions focus on the key ecosystem elements that are most relevant to the management questions and objectives, human values, or resource conditions within the analysis area. The Characterization section places the Applegate-Star/Boaz Watershed Analysis Area in context within the Applegate River Subbasin. It identifies the dominant physical, biological, and human processes or features of the analysis area that affect ecosystem functions or conditions. The Current Conditions section details current conditions of the physical, biological, and human ecosystem elements. The Reference Conditions section describes how ecological conditions have changed over time as a result of human influences and natural disturbances in the Applegate-Star/Boaz Watershed Analysis Area. The Synthesis and Interpretation section compares existing and reference conditions of specific ecosystem elements and explains significant differences, similarities, or trends and their causes. The Management Objectives and Recommendations section identifies management objectives for federal lands within the Applegate-Star/Boaz Watershed Analysis Area and prioritizes management activities to achieve the objectives. The Landscape Planning section synthesizes resource data to create landscape objectives and recommendations for federal lands. Prioritized data gaps and monitoring and research needs are included in separate sections.

Maps are grouped together and placed at the end of the document. All maps for the watershed analysis were generated using BLM Medford District geographic information systems (GIS).

Public Involvement

Public participation for the Applegate-Star/Boaz Watershed Analysis Area built upon previous analysis and public involvement efforts in the Applegate area. Issues, concerns, and conditions identified in previous documents for the Applegate River Subbasin were used as a basis for developing the issues and key questions for the Applegate-Star/Boaz Watershed Analysis.

Letters were sent in March 1996 to the Confederated Tribes of Siletz and Grand Ronde notifying them of the watershed analysis and requesting comments. A letter regarding the

watershed analysis was sent in May 1996 to residents within the analysis area and local groups including: the Applegate Partnership, Applegate River Watershed Council, Applegate Watershed Conservancy, North Applegate Watershed Association, Carberry Creek Association, Headwaters, Threatened and Endangered Little Applegate Valley, Southern Oregon Timber Industry Association, and Applegate Stockman's Association. The letter provided a map of the area, explained watershed analysis, requested information and recommendations for the analysis area, and asked for interest in a field trip. A notice containing similar information was published in the "Applegator" (Applegate Partnership Newsletter) and posted at several local public places (Star Ranger Station, Ruch Information Center, Ruch Library, and Applegate Grange). Six letters were returned, four with comments and four expressing interest in a field trip. Comments are summarized as follows.

- 1) Incorporate concerns and objectives from the Beaver-Silver Coordinated Resource Management Plan (CRMP).
- 2) No more logging or road building.
- 3) Sustained yield timber harvest that ensures the preservation of watershed quality and forest character.
- 4) Restore damaged watershed areas.
- 5) Provide information regarding the need for downed trees in the river.
- 6) Prohibit fishing in the river until stocks are sustainable.
- 7) Restrict access to people boating in the river.
- 8) Prohibit pesticide use near the river and along the road.
- 9) Prohibit dredging in the river.
- 10) Provide more road cleanup and a slower speed limit.
- 11) Prohibit logging except for dead snags.
- 12) Plant more trees along the river.
- 13) Limit population growth in the Applegate.

The Applegate-Star/Boaz Watershed Analysis team hosted a field trip to the analysis area on August 2, 1996. Two members of the public attended. Preliminary issues and key questions were discussed. Resource specialists gave an overview of their resource during the field trip. Public questions concerning fish and wildlife habitat, vegetation (trees/plants), hydrology, and fire were addressed during the field trip. Additional issues, concerns, thoughts, or ideas were solicited from those attending. No new issues were received.

Notification of the field trip was through a mass mailing to local residents, local and regional interest groups, and to most local, state, and federal agencies in Jackson and Josephine counties. The mailer also provided an opportunity to return written comments for those people interested, but unable to attend the field trip. No comments were received.

ISSUES AND KEY QUESTIONS

ISSUE: *Human Uses*

Characterization

1. What are the land ownership patterns in the analysis area?
2. What are the major ways in which humans interact with the analysis area?
3. Where are the primary locations for human use of the analysis area?
4. What are the regional public concerns that are pertinent to the analysis area (e.g., air quality, environmental degradation, commodity production)?
5. What are the public concerns specific or unique to the analysis area?

Current Conditions

1. What is the human dimension of the physical environment?
 - a. Native Americans (treaty or tribal rights?)
 - b. Cultural resources (archaeological sites: existing and predicted)
 - c. Recreation
 - d. Facilities and structures (e.g., work stations, gaging stations)
 - e. Authorized and unauthorized uses
 - f. Special designated areas
 - g. Special forest products
 - h. Logging
 - i. Grazing
 - j. Mining claims
2. Who are the people most closely associated with and potentially concerned about the analysis area?
3. What are the current human uses and trends of the analysis area (economic, recreational, other)?
4. What is the current and potential role of the watershed in the local and regional economy?

Reference Conditions

1. How did native peoples interact with the environment to create the native reference ecosystem?
2. What changes in human interactions have taken place since historic contact and how has this affected the native ecosystem?
3. What are the major historical human uses in the analysis area, including tribal and other cultural uses?

ISSUE: Human Uses (continued)

Synthesis and Interpretation

1. What are the causes of change between historical and current human uses?
2. What are the influences and relationships between human uses and other ecosystem processes in the analysis area?
3. What human effects have fundamentally altered the ecosystem?
4. What are the anticipated social or demographic changes that could affect ecosystem management?
5. What human interactions have been and are currently beneficial to the ecosystem and can these be incorporated into current and future land management practices?

ISSUE: Roads

Characterization

1. What road types are in the analysis area and where are they located?

Current Conditions

1. What are the current road conditions?
2. What is the road density (by road type) and where are high road densities located?

Reference Conditions

1. What is the history of road development and use in the analysis area?

Synthesis and Interpretation

1. What are the influences and relationships between roads and other ecosystem processes?
2. How do road stream crossings affect water quality, instream habitat, and fish migration?

ISSUE: Climate

Characterization

1. What are the climatic patterns in the analysis area?

ISSUE: Erosion Processes

Characterization

1. What erosion processes are dominant within the analysis area?
2. Where have they occurred or are they likely to occur?

Current Conditions

1. What are the current conditions and trends of the dominant erosion processes prevalent in the analysis area?

Reference Conditions

1. What are the historical erosion processes within the analysis area?
2. Where have they occurred?

Synthesis and Interpretation

1. What are the natural and human causes of changes between historical and current erosion processes in the analysis area?
2. What are the influences and relationships between erosion processes and other ecosystem processes?

ISSUE: Soil Productivity

Characterization

1. How critical/vulnerable is soil productivity in the analysis area?

Current Conditions

1. What are the current conditions and trends of soil productivity?
2. What areas within the analysis area are most vulnerable to soil productivity loss by management actions?

Reference Conditions

1. What were the historical soil productivity characteristics?

Synthesis and Interpretation

1. What are the natural and human causes of change between historical and current soil productivity conditions?
2. How do natural disturbances affect long-term soil productivity?
3. What are the influences and relationships between soil productivity and other ecosystem processes?

ISSUE: *Vegetation Density and Vigor*

Characterization

1. What are the array and landscape pattern of native plant communities and seral stages in the analysis area?
2. What processes caused these patterns?
3. What is the percent composition of the vegetation condition classes over the landscape?
4. What tree series/plant associations are found in the analysis area?

Current Conditions

1. What are the current conditions and trends of the prevalent plant communities and seral stages in the analysis area?
2. What are the site indices of the soils and how do they relate to present tree growth?
3. What vegetation condition classes are not meeting their growth potential?
4. What are the major mechanisms of vegetation disturbance?
5. Do some vegetation condition classes promote insect and disease problems?
6. Where are the tree insect and disease problem areas?

Reference Conditions

1. What is the historical array and landscape pattern of plant communities and seral stages in the analysis area?
2. What processes caused these patterns?
3. What was the historical tree growth pattern?
4. Were tree insects and disease a problem historically?

Synthesis and Interpretation

1. What are the natural and human causes of change between historical and current vegetative conditions?
2. What are the influences and relationships between vegetation and seral patterns and other ecosystem processes in the analysis area?
3. Which processes or causal mechanisms are most likely responsible for similarities, differences, and trends?
4. What are the implications of the changes and trends, including the capability of the watershed to achieve objectives from existing plans?
5. What are the reasons for differences between current and reference tree growth patterns?

ISSUE: *Plant Species and Habitats*

Characterization

1. Special Status Plant Species and Habitats
 - a. What is the relative abundance and distribution of special status plant species?
 - b. What is the distribution and character of their habitats?
2. Survey and Manage Plant Species and Habitats
 - a. What is the relative abundance and distribution of survey and manage plant species?
 - b. What is the distribution and character of their habitats?
3. Noxious Weeds
 - a. What is the relative abundance and distribution of noxious weeds?
 - b. What is the distribution and character of their habitats?

Current Conditions

1. Special Status Plant Species and Habitats
 - a. What are the current habitat conditions and trends for special status species?
2. Survey and Manage Plant Species and Habitats
 - a. What are the current habitat conditions and trends for survey and manage species?
3. Noxious Weeds
 - a. What are the current habitat conditions and trends for noxious weeds?

Reference Conditions

1. Special Status Plant Species and Habitats
 - a. What was the historical relative abundance and distribution of special status species and the condition and distribution of their habitats in the analysis area?
2. Survey and Manage Plant Species and Habitats
 - a. What was the historical relative abundance and distribution of survey and manage species and the condition and distribution of their habitats in the analysis area?
3. Noxious Weeds
 - a. What was the historical relative abundance and distribution of noxious weeds and the condition and distribution of their habitats in the analysis area?

Synthesis and Interpretation

1. Special Status Plant Species and Habitats
 - a. What are the natural and human causes of change between historical and current species distribution and habitat quality for special status species in the analysis area?
 - b. What are the influences and relationships of special status species and their habitats with other ecosystem processes in the analysis area?
2. Survey and Manage Plant Species and Habitats
 - a. What are the natural and human causes of change between historical and current species distribution and habitat quality for survey and manage species in the analysis area?
 - b. What are the influences and relationships of survey and manage species and their habitats with other ecosystem processes in the analysis area?

ISSUE: *Plant Species and Habitats (continued)*

Synthesis and Interpretation (continued)

3. Noxious Weeds

- a. What are the natural and human causes of change between historical and current species distribution and habitat quality for noxious weeds in the analysis area?
- b. What are the influences and relationships of noxious weeds and their habitats with other ecosystem processes in the analysis area?

ISSUE: *Fire*

Characterization

1. What is the fire regime?

Current Conditions

1. What role does fire currently have?
2. What are the current fire hazards and risks?
3. What are the high values at risk that could be impacted by a wildfire?
4. How is air quality impacted by prescribed fire and wildfires?

Reference Conditions

1. What was the historic role of fire within the analysis area?

Synthesis and Interpretation

1. How have fire suppression efforts over the past 80 years caused changes between the historical and current role of fire?
2. How has the fire role change caused differences between historical and current vegetative species distribution?

ISSUE: *Terrestrial Wildlife Species and Habitats*

Characterization

1. Wildlife Habitat - General

- a. What is the distribution and character of the various habitat types found in the analysis area?

2. Threatened/Endangered Species

- a. What threatened or endangered species are found in the analysis area?
- b. What is the acreage of northern spotted owl critical habitat?

ISSUE: Terrestrial Wildlife Species and Habitats (continued)**Characterization (continued)****3. Survey and Manage Species**

- a. What survey and manage species are found in the analysis area?

4. Special Status Species

- a. What special status species of management concern are in the analysis area?

Current Conditions**1. Wildlife Habitat - General**

- a. What are the current habitat conditions and trends for the various habitat types found in the analysis area?

2. Late-Successional Habitat

- a. What percent of the forest land in the fifth field watershed has late-successional characteristics?

3. Threatened/Endangered Species

- a. What are the current conditions and trends for northern spotted owl habitat found in the analysis area?
- b. What is the current role of the designated spotted owl critical habitat in the analysis area?

4. Survey and Manage Species

- a. What are the current habitat conditions and trends for the survey and manage species found in the analysis area?

5. Special Status Species

- a. What are the current habitat conditions and trends for the special status species of management concern found in the analysis area?

Reference Conditions**1. Wildlife Habitat - General**

- a. What was the historical relative abundance, condition, and distribution of the various habitat types found in the analysis area?

2. Threatened/Endangered Species

- a. What was the historical acreage, condition, and distribution of northern spotted owl habitat in the analysis area?
- b. What was the initial role of the northern spotted owl critical habitat in the analysis area?

3. Survey and Manage Species

- a. What was the historical amount, condition, and distribution of habitat for the survey and manage species found in the analysis area?

ISSUE: *Terrestrial Wildlife Species and Habitats (continued)*

Reference Conditions (continued)

4. Special Status Species

- a. What was the historical amount, condition, and distribution of habitat for the special status species of management concern found in the analysis area?

Synthesis and Interpretation

1. Wildlife Habitat - General

- a. What are the implications of natural and human-caused change between historical and current relative abundance, condition, and distribution of the various habitat types found in the analysis area?

2. Threatened/Endangered Species

- a. What are the implications of natural and human-caused change between historical and current acreage, condition, and distribution of northern spotted owl habitat in the analysis area?
- b. What are the implications of the change in role of the northern spotted owl critical habitat in the analysis area?

3. Survey and Manage Species

- a. What are the implications of natural and human-caused change between historical and current amounts, conditions, and distribution of habitat for survey and manage species found in the analysis area?

4. Special Status Species

- a. What are the implications of natural and human-caused change between historical and current amounts, conditions, and distribution of habitat for special status species of management concern found in the analysis area?

ISSUE: Hydrology

Characterization

1. What are the dominant hydrologic characteristics and other notable hydrologic features and processes in the analysis area?

Current Conditions

1. What are the current conditions and trends of the dominant hydrologic characteristics and features prevalent in the analysis area?

Reference Conditions

1. What are the historical hydrologic characteristics and features in the analysis area?

Synthesis and Interpretation

1. What are the natural and human causes of change between historical and current hydrologic conditions?
2. What are the influences and relationships between hydrologic processes and other ecosystem processes?

ISSUE: Stream Channel

Characterization

1. What are the basic morphological characteristics of stream valleys or segments and the general sediment transport and deposition processes in the analysis area?

Current Conditions

1. What are the current conditions and trends of stream channel types and sediment transport and deposition processes prevalent in the analysis area?

Reference Conditions

1. What were the historical morphological characteristics of stream valleys and general sediment transport and deposition processes in the analysis area?

Synthesis and Interpretation

1. What are the natural and human causes of change between historical and current channel conditions?
2. What are the influences and relationships between channel conditions and other ecosystem processes in the analysis area?

ISSUE: *Water Quality*

Characterization

1. What beneficial uses dependent on aquatic resources occur in the analysis area?
2. Which water quality parameters are critical to these uses?

Current Conditions

1. What are the current conditions and trends of beneficial uses and associated water quality parameters?

Reference Conditions

1. What were the historical water quality characteristics of the analysis area?

Synthesis and Interpretation

1. What are the natural and human causes of change between historical and current water quality conditions?
2. What are the influences and relationships between water quality and other ecosystem processes in the analysis area?

ISSUE: *Riparian Areas*

Characterization

1. What is the array and landscape pattern of plant communities and seral stages in the riparian areas?
2. What processes caused these patterns?
3. What riparian-dependent wildlife species are found in the analysis area?

Current Conditions

1. What is the current species composition of riparian areas?
2. What are the current conditions and trends of riparian areas?
3. Where are sensitive areas and what are the reasons for sensitivity?

Reference Conditions

1. What was the historical condition of riparian areas?
2. What was the historical species composition of riparian areas?

Synthesis and Interpretation

1. What is the influence of natural watershed characteristics and human activities on riparian areas?
2. How have these influences changed riparian areas?
3. What is the effect of riparian condition on instream habitat?
4. What are the influences and relationships between riparian areas and other ecosystem processes in the analysis area?

ISSUE: Aquatic Wildlife Species and Habitats**Characterization**

1. What is the relative abundance and distribution of special status aquatic wildlife species?
2. What is the distribution and character of their habitats?

Current Conditions

1. What are the current conditions and trends of instream habitat (i.e., quantity, quality, and life history stages) for fish and other aquatic animals?
2. How does instream habitat in the analysis area fit into the "big habitat picture" for the Applegate fish stocks?

Reference Conditions

1. What was the historical relative abundance and distribution of species of concern and the condition and distribution of instream habitats for fish and other aquatic animals in the analysis area?

Synthesis and Interpretation

1. What is the influence of natural watershed characteristics and human activities on species distribution and instream habitat condition?
2. How have these influences changed instream habitat condition?
3. How have changes in habitat condition influenced Applegate fish stocks and other aquatic species?
4. What are the limiting factors for long-term sustainability of fish and other aquatic species?
5. What are the influences and relationships of aquatic species and their habitats with other ecosystem processes in the analysis area?

WATERSHED CHARACTERIZATION

The purpose of the Characterization section is to identify the dominant physical, biological, and human processes or features of the watershed that affect ecosystem functions or conditions. The watershed ecosystem elements are related to those occurring in the river basin or province. The watershed analysis team identified the relevant land allocations and the most important plan objectives and regulatory constraints that influence resource management in this watershed.

The Applegate-Star/Boaz Watershed Analysis Area is a 28-square mile (17,651 acres) area within the Applegate River Subbasin (Map 1). The Applegate River Subbasin is one of seven subbasins within the Rogue River Basin in southwest Oregon (OWRD 1989). A detailed characterization at the subbasin scale may be found in the *Applegate Adaptive Management Area Ecosystem Health Assessment* (USDA and USDI 1994b).

The Applegate-Star/Boaz Watershed Analysis Area includes all land draining into the Applegate River from the mouth of the Little Applegate River to just upstream of Boaz Gulch (Map 2). Star Gulch is the major drainage within the analysis area. The nearby towns are Applegate and Ruch; Ruch also serves as a social confluence for Upper Applegate residents (Priester 1994). Jackson County Highway 859 parallels the Applegate River and connects the analysis area with Oregon State Highway 238 to the north.

The Northwest Forest Plan designated two land use allocations for federal lands in the Applegate-Star/Boaz Watershed Analysis Area, which are the Riparian Reserves and the Applegate Adaptive Management Area (AMA) (Table 1 and Map 3). Riparian Reserve acres are dependent on two factors: stream category and site potential tree height. Stream category was estimated for the watershed analysis and needs to be verified on-the-ground during site-specific analysis.

Table 1. Federal Land Use Allocations

Federal Land Use Allocations	Acres
Applegate Adaptive Management Area	15,355
Riparian Reserves ¹ (within AMA)	6,126

1/ Riparian Reserves acres are based on estimates of stream category.

Source: Modified BLM GIS

HUMAN USES

Land ownership is a mix of private and public (Table 2 and Map 4). Private lands are used for residences and economic pursuits, which include agriculture, ranching, and timber harvest.

Individual ranches and residences are located mainly in the valley along the Applegate River. Superior Lumber and Boise Cascade are two timber corporations that have some land ownership in the uplands. Superior Lumber owns Section 16 in T.39S., R.3W. (640 acres). Boise Cascade owns Section 36 in T.39S., R.4W., with approximately 150 acres of Section 36 being in the analysis area.

Table 2. Land Ownership

Ownership	Acres	Percent
Bureau of Land Management (Medford District, Ashland Resource Area)	14,811	83.9
U.S Forest Service (Rogue River National Forest, Applegate Ranger District)	544	3.1
Private	2,296	13.0
Total	17,651	100.0

Source: Medford BLM Geographical Information System (GIS)

County records reveal the following information regarding private land ownership in the watershed.

- There are approximately 83 private parcels in the Applegate-Star/Boaz Watershed Analysis Area.
- Seventy-eight of the parcels within the area drain directly into the Applegate River and most are in the north-south oriented river corridor area.
- Only five private parcels are partially or completely within Star Gulch watershed.
- Private parcels (individual and corporate) range in size from 640 acres down to 1 acre.
- Mailing addresses may not coincide exactly with the number of parcels. One owner may own two or more individual parcels (tax lots) or there may be more than one mailing address attached to a given parcel.

Most of the analysis area is managed by the Bureau of Land Management (BLM). Public lands are managed for both commodity extraction (logging, mining, special forest products, and grazing) and noncommodity purposes (wildlife, water quality, and dispersed recreation, such as hunting and camping).

Rural interface zones are areas where rural residential and/or farm/forest zoning occur within one-half mile of adjoining BLM-managed land. Rural interface is primarily found in the Applegate River corridor.

Regional and local concerns include fire-related issues, economic development, and environmental degradation. State land use planning is an issue for the private lands and decisions made regarding zoning can have significant effects on nearby federal lands.

ROADS

Roads within the analysis area are owned or managed by the BLM, Forest Service, timber companies, Jackson County, and many private landowners. Oregon State Highway 238, which connects Jacksonville and Provolt, is a major transportation corridor north of the Applegate-Star/Boaz Watershed Analysis Area. Jackson County Highway 859 (Applegate Road) divides the analysis area along the west side of the Applegate River.

Travel routes in the analysis area are used for recreation, resource management, and private property access. These routes are used by cars, trucks, construction and farming equipment, motorcycles, bicycles, horses, pedestrians, and other modes of transportation. The BLM strives to provide a transportation system for many different recreational experiences and management opportunities while simultaneously protecting resources, minimizing safety hazards, and reducing user conflicts.

The analysis area has three basic road surface types: main access roads with a bituminous (asphalt) surface, roads with a rock surface, and roads with no surface protection (natural surfaced). Main access roads may have a crushed rock surface, but usually have a bituminous surface. Roads leading into main access roads usually have a crushed rock surface and dead-end spurs often have a natural surface. An adequately surfaced road generally allows for year-round travel.

There are two developed quarries in the analysis area (T.39S., R.4W., Section 22 and T.39S., R.3W., Section 34) where BLM may obtain rock for surfacing roads and drainage protection.

Road maintenance is conducted by the different owners and management agencies. During dry weather periods, water, oil, or lignin may be applied to road surfaces; this is necessary for dust abatement, placing surface rock, and to keep roads from disintegrating. The BLM obtains water from several developed water sources in the analysis area.

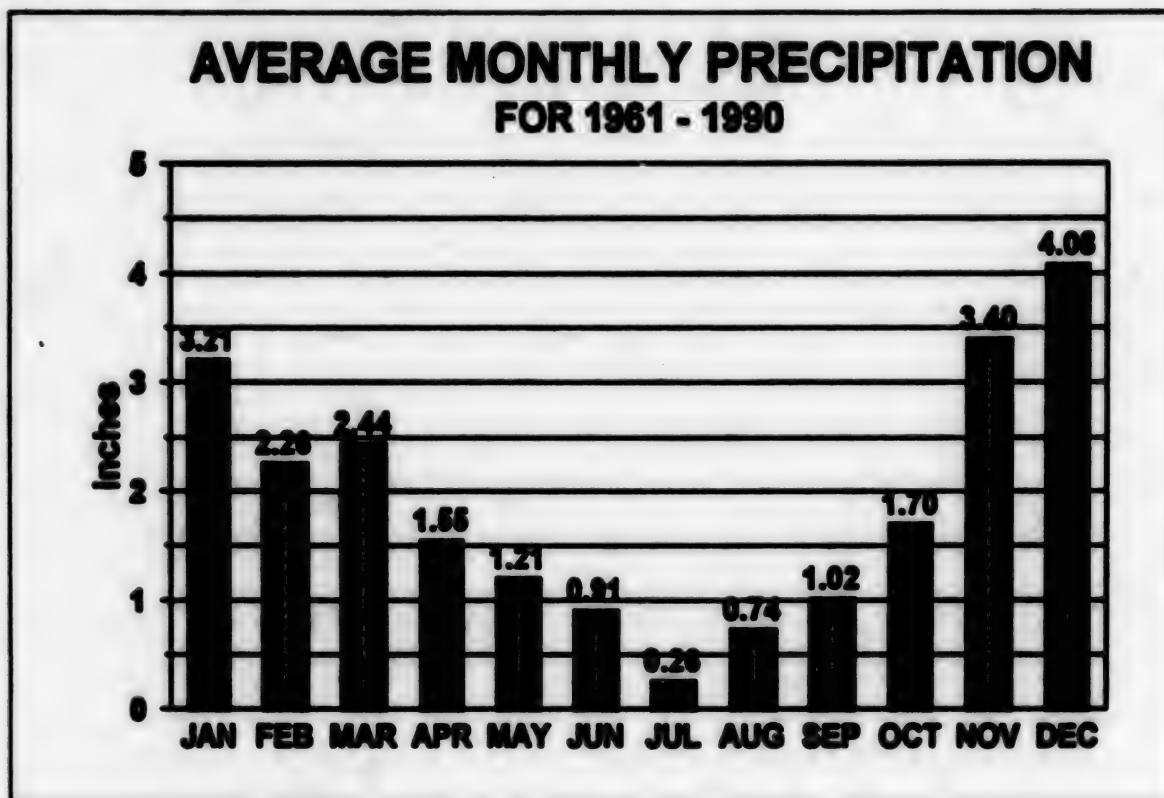
CLIMATE

The Applegate Valley is one of the driest areas west of the Cascade Mountains. The rain shadow effect created by the Siskiyou and Coast ranges results in relatively light annual rainfall, the majority of which occurs in the late fall, winter, and early spring (USDI 1994). Average annual precipitation in the Applegate-Star/Boaz Watershed Analysis Area ranges from approximately 26 inches near the Applegate River (elevation 1,440 feet) to 52 inches at Palmer Peak (elevation 4,736 feet) (Map 5). Precipitation usually occurs in the form of rainfall over most of the analysis area, although, a mixture of snow and rain occurs between approximately 3,500 and 5,000 feet. The snow level in this zone fluctuates throughout the winter in response to alternating warm and cold fronts. This elevation band is referred to as either the "rain-on-snow dominated zone" or the "transient snow zone" and comprises 21 percent of the Applegate-Star/Boaz Watershed Analysis Area (Map 6).

The National Oceanic and Atmospheric Administration (NOAA) weather station at Buncom,

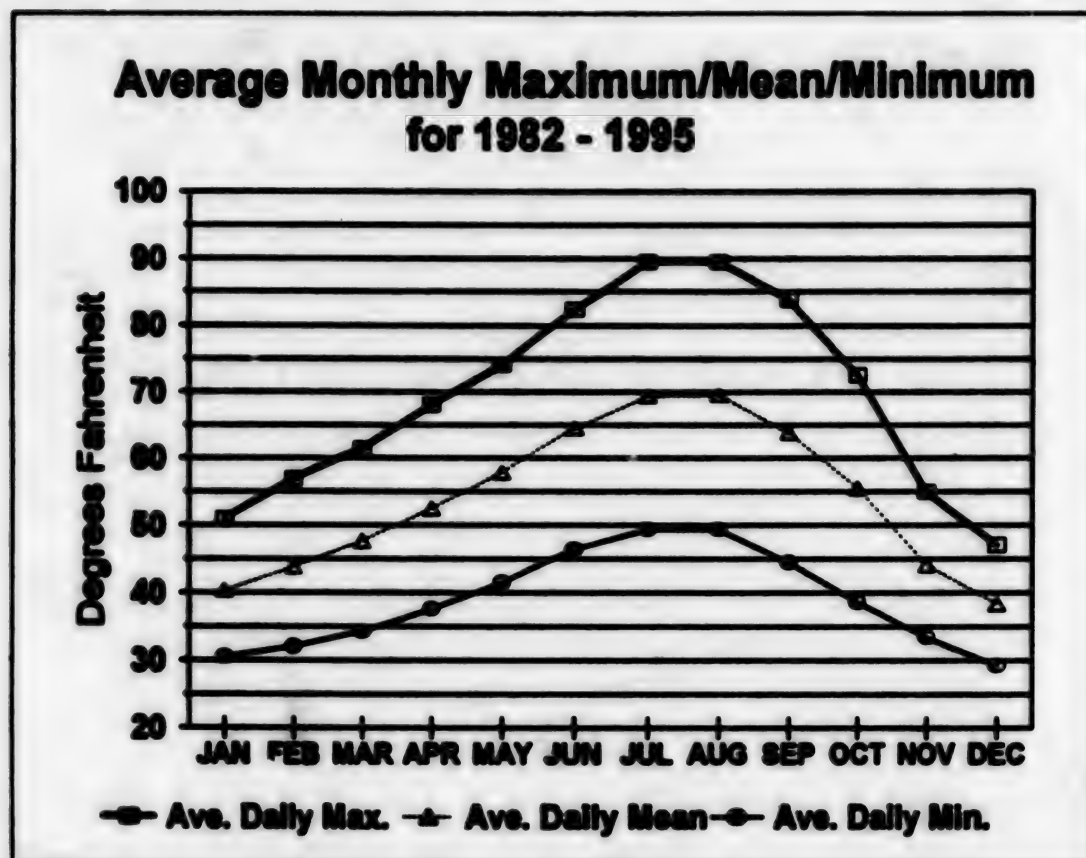
located approximately 1.5 miles east of the Applegate-Star/Boaz Watershed Analysis Area, has the most complete precipitation record of any station in the vicinity. Precipitation distribution at Buncom by monthly average is shown on Figure 1. The majority of precipitation falls during November through March (68 percent of the yearly total). Annual precipitation fluctuates widely from year-to-year in the Applegate Valley. The 30-year average (normal) annual precipitation at Buncom is 22.8 inches (NOAA 1994). Below normal precipitation has occurred during 6 of the past 10 years (through water year 1996).

Figure 1. Precipitation at Buncom



Source: Climatological Data Annual Summary, Oregon (NOAA 1994)

The nearest NOAA weather station with air temperature data is located in Ruch, approximately three miles north of the analysis area. Average monthly maximum, mean, and minimum air temperatures for Ruch are displayed in Figure 2. Summer months are predominately hot and dry with maximum daytime temperatures averaging 89°F in Ruch during July and August (1982-1995). Summer temperatures normally are accompanied by low humidity typical of a Mediterranean-type climate (USDI 1994).

Figure 2. Air Temperatures at Ruch¹

1/ Station inactive 5/92 - 10/92; additional 15 months have partial data, 4 months have no data; probably available from NOAA.

Source: Climatological Data Annual Summary, Oregon (NOAA 1994)

Based on tree-ring growth rates and recorded meteorological data, the past 200 to 300 years have probably been marked by cycles of hot, dry spells and temperate-to-cool weather that have lasted varying periods (LaLande 1995). Current climatic patterns need to be viewed with a long-term perspective.

EROSION PROCESSES

Geology and soils in the analysis area are similar to those found in adjacent watersheds (Middle Applegate, lower Little Applegate River, and Beaver/Palmer). Soils have formed from metasedimentary and metavolcanic rock (USDA 1993). Soils and landforms are generally quite stable under natural vegetative cover, having few landslides or extreme surface erosion.

The two dominant types of erosion processes are gravity and concentrated water flow. Erosion by gravity is predominately on very steep slopes in areas mapped by the Soil Conservation Service (USDA 1993) as Caris-Offenbacher soil complex (Map 7). These are well-drained, moderately deep soils with gravelly loam surface layers over loam or gravelly loam subsoil. The gravel surface lag has been derived from rock outcrops on ridge crests and protruding

knobs. The gravelly surface or ravel moves slowly downslope on steep and very steep slopes. The gravel is typically one to six inches thick. Thicker accumulations of gravel are typically found in draws. These conditions are most common on south-facing slopes in the Star Gulch area and on west-facing slopes on the eastside of the Applegate River in the analysis area.

Stream channels are natural forms of concentrated water erosion. Rills and gullies can form when the rainfall rate exceeds a soil's capability to absorb the water. The resultant soil erosion is the source of fine sediments (sand size and finer) in streams. Granitic soils in the watershed, which include Tallowbox gravelly sandy loam, are most susceptible to erosion when void of vegetation. Granitic soils occur on the outer west and south edges of the analysis area (Map 7). Vannoy silt loam soils are also of concern because of their relatively low permeability. The silt loam surface layer will cause water to accumulate on the surface, especially during periods of intense rainfall. Vannoy typically occurs on steep lower slopes and some broad upper slopes throughout the analysis area (Map 7).

SOIL PRODUCTIVITY

Soil productivity is determined by characteristics, such as rooting depth, water holding capacity, cation exchange capacity, and bulk density. These properties provide the framework on which organic and biological processes occur. Climate, slope gradient, and aspect are environmental and physical elements that affect productivity.

Soil productivity ratings have been developed for the analysis area based on the soil productivity factors, SCS soil survey data (USDA 1993), and conifer growth rates. Map 8 illustrates six levels of productivity. They include four ratings for conifer lands: very low, low, medium, and high; and separate ratings for nonforest and agricultural land. The higher sites occur on northerly and easterly aspects and in drainageways. Lower sites are on southerly and westerly aspects and on ridge crests.

Biological and physical properties can be altered where surface disturbance occurs. Biological properties are determined predominantly by the organic matter both within the soil and above the soil in the form of duff, litter, and coarse woody material (tree limbs, boles, and stumps). Duff and litter are composed of fine, decaying, distinguishable, and indistinguishable vegetative material, which is a source of nutrients that is made available to plants by soil organisms. They help conserve soil moisture by reducing evaporation and protecting the soil against erosion that would cause a reduction in soil productivity. The thickness of duff and litter in the analysis area is estimated to be one to four inches, which is a moderate thickness (McCrimmon and Atzet 1992). South aspects and low elevation sites have thin litter layers and are not as productive as north aspects and higher elevation sites. South aspects are particularly at risk to productivity loss due to wildfire.

The soil physical properties that are most often affected by surface disturbance are bulk density and water holding capacity. When soils are compacted, bulk density is increased and waterholding capacity is reduced, which results in a reduction in soil productivity.

VEGETATION DENSITY AND VIGOR

The Applegate-Star/Boaz Watershed Analysis Area is located in the Siskiyou Mountains of the Klamath Geologic Province. These mountains, which are renowned for their vegetative diversity, are a meeting ground for three of the ten floristic provinces found in the continental United States. The three provinces are the Cordilleran Forest, the Californian or Chaparral, and the Great Basin. The Cordilleran Forest Province contains the conifers of the north, which include Douglas-fir, ponderosa and lodgepole pine, cedars, and hemlocks. The Californian or Chaparral Province is the most diverse in the United States (Gleason and Cronquist 1964). As a result of this blending and mixing of vegetative types, the area is botanically very valuable and highly significant in the long-term migration and evolutionary trends of flora in the western United States.

The Siskiyou Mountains are the northern most range in the Klamath Geologic Province. They have escaped destruction of their native flora by glaciation or volcanic activity for more than 100 million years (Waring 1969). This has enabled the area to be a refugia for plant species that were eliminated in other areas. For example, Brewer's spruce (*Picea breweriana*) is a very uncommon conifer species found only in the Siskiyou Mountains. Fossil records reveal that it existed as far away as northeastern Oregon (Waring et al. 1975).

Distribution and landscape patterns of plant species and communities are controlled primarily by physical factors of the environment, which include moisture, temperature, light, and soil type. Waring (1969) found that in the eastern Siskiyou, where the Applegate-Star/Boaz Watershed Analysis Area is located, moisture and temperature proved to be the most important factors limiting vegetation. The eastern Siskiyou are hotter and drier than the western Siskiyou, and many species found in the western Siskiyou cannot tolerate the moisture and heat stress of the eastern Siskiyou (Waring 1969).

In the Klamath Geologic Province, favorable moisture conditions with warm temperatures permit the existence of remnants of the Arcto-Tertiary Geo-flora (Whittaker 1960). The climatic variation together with the varied topography has permitted a wide range of plant communities to develop. These varied habitats have enabled species with diverse environmental requirements to persist in the area and/or to migrate into the region from the north, south, east, and west (Waring 1969). The physical orientation of the Siskiyou Mountains, running east-west between the coast range and the Cascade range, provides a major migratory route for both plants and animals. The unique geology of the area has been instrumental in the development of many local endemic plant species, which occur only in the Siskiyou Mountains. Four examples of these endemics that occur in the analysis area are: Gentner's Fritillary (*Fritillaria gentneri*), Applegate stonecrop (*Sedum oblongeolatum*), Depauperate stonecrop (*Sedum radiatum* sp. *depauperatum*), and Heckner's stonecrop (*Sedum laxum* sp. *heckneri*). Many plant genera show high concentrations of their species, including endemics, (Whittaker 1960) and is also true of the *Sedums*. The varied topography and climatic conditions of the Siskiyou Mountains have contributed to the abundance of special status plant species known or suspected to occur in the Applegate-Star/Boaz Watershed Analysis Area.

Landscape Patterns

The present day landscape pattern of vegetation in the Applegate-Star/Boaz Watershed Analysis Area is the result of climate, topography, forest replacing fires, timber harvesting, and agricultural/residential development. These influences have produced a landscape pattern with large openings created by fire, logging, and development, and smaller openings created by mortality from insects, disease, and blowdown. Conifers appear to grow in suitable microsites surrounded by oak woodlands, shrublands, and grasslands creating a natural fragmentation of forest lands across the landscape.

At the stand level, the forest structure is quite homogeneous in the analysis area. Most of the stands across the analysis area are primarily even-aged with a single canopy layer and a high number of trees in relatively small diameter classes. There are few trees per acre over 30 inches in diameter. A limited number of trees bearing old-growth characteristics are found scattered throughout the overstory. When an understory is present, it is primarily Douglas-fir and pacific madrone due to the shade tolerance of these species.

Douglas-fir stands with late-successional characteristics exist where natural disturbances have occurred at lower intensities. These stands have greater diversity in diameter classes, tree heights, and seral stages, and the ecosystem processes are numerous and complex. In the analysis area south of Star Gulch, dwarf mistletoe is common in Douglas-fir and tends to decrease tree vigor. Mistletoe, combined with high vegetation stocking levels, has decreased tree vigor enough to allow bark beetle populations to expand and cause tree mortality. The largest, oldest Douglas-fir trees are dying, thus allowing younger trees to become established. Many natural openings in various stages of seral development are evident. Tree windthrow plays a role by creating openings in high elevation stands.

The development patterns of late-successional pine stands are more obscure. Pine, 130 years and older, are still evident in the overstory and Douglas-fir is the most abundant species in the understory. Pine species are unable to regenerate due to the lack of wildland fire disturbances and the competition from more shade-tolerant Douglas-fir. Only on the harshest sites, can ponderosa pine out-compete Douglas-fir and develop late-successional characteristics.

Vegetation Condition Classes

The vegetation condition classes listed in Table 3 and shown on Map 9 were defined in the *Medford District Watershed Analysis Guidelines* (USDI 1994a). Percent of land area in these vegetation classes are derived from the Geographic Information System (GIS).

Table 3. Vegetation Condition Classes

Vegetation Condition Class	Acres	Percent of Area
Grass, forbs, herbaceous vegetation	1,170	7
Shrubs, non-forest land	517	3
Hardwood/woodland	4,058	23
Early (0 to 5 years) and seedling/sapling (0-4.9" dbh)	1,511	9
Pole (5-11" dbh)	2,289	13
Mid (large poles, 11-21" dbh)	5,907	33
Mature/old-growth (21+ " dbh)	2,200	12

Tree Series/Plant Associations

There are at least 16 tree series in the Klamath Geologic Province (Atzet and Martin 1991). Three of these series, Douglas-fir, ponderosa pine, and white oak, are found in the Applegate-Star/Boaz Watershed Analysis Area. Plant associations for the three series are listed in Table 4. The association descriptions can be found in Preliminary Plant Associations of the Siskiyou Mountain Province (Atzet and Wheeler 1984). Although the white fir series is not specifically listed as being found in this area, small white fir stands are found on the southwestern ridgetops. The presence of white fir quickly gives way to Douglas-fir and pine species as the elevation decreases.

Table 4. Tree Series/Plant Associations

Douglas-fir Series/Plant Associations	Ponderosa Pine Series/Plant Associations	White Oak Series/Plant Associations
PDMS (Douglas-fir)/PDMS (dwarf Oregon grass)	PFO (Ponderosa Pine) /PDMS (Douglas fir)	QUOA (Oregon white oak)/CYEC (Hedgerow shrub)
PDMS/SHDI (Pole oak)-SEPI (Piper Oregon grass)		QUOA/BCA (California Broom)
PDMS/SHDI		QUOA/PRYS (Woods strawberry)
PDMS/REDUCTOR (Pacific Ironwood tree)		
PDMS/PFO (Ponderosa Pine)		
PDMS/ABCO (White fir)		
PDMS/ABCO/PFO		
PDMS/Dominants		
PDMS/CICU (Wetland conifers)		

Aspect, slope position, and elevation play an important role in determining vegetation species and vigor for a particular site. Northwest to northeast slopes tend to be cooler and moister and favor cool, moist, plant indicator species. Southwest to southeast aspects are the harshest sites. In

southwestern Oregon where rainfall is limiting and forest soils are shallow, the bottom of a slope is generally a more productive site. This is due to water draining to the bottom of the slope from the higher elevations, which receives more moisture than lower elevations.

PLANT SPECIES AND HABITATS

Special Status Plant Species and Habitats

Eight special status plant species are known to exist in the Applegate-Star/Boaz Watershed Analysis Area. BLM manages several different plant species because they are limited in abundance and distribution with identifiable threats to their habitats. The following are categories for special status plant species.

- Species listed by the U.S. Fish and Wildlife Service (USFWS) as threatened or endangered (T/E).
- Species proposed for listing by USFWS as threatened or endangered (PT/PE).
- Species identified as a candidate for listing as threatened or endangered (FC) (Endangered Species Act of 1973, as amended).
- Species of concern (SOC) (Former Federal Candidate category 2).
- Species identified as State Listed (SL).
- Species identified as Bureau Sensitive in Oregon (BSO).
- Species identified as Bureau Assessment in Oregon (BAO).
- Species whose population numbers are Being Tracked in Oregon (BTO).

Inventories for special status plant species have been occurring on the Medford District since 1977. Inventories are done in conjunction with ground-disturbing activities. Inventories in the Applegate-Star/Boaz Watershed Analysis Area began in the early 1980s. Table 5 lists the species found, their status, habitat requirements, and number of known sites. These 31 sites represent less than 25 percent of the analysis area having been surveyed. There is a potential for several other special status plants to occur in the analysis area based on habitat preference and known populations in adjacent watersheds.

Table 5. Special Status Vascular Plants

Species	Status	Habitat Requirement	Number of Sites
<i>Cypripedium fasciculatum</i> Clustered lady's slipper	SOC/BSO S&M	Late successional forest	14
<i>Cypripedium montanum</i> Mountain lady's slipper	BTO S&M	Late successional forest	6
<i>Fritillaria gowdardii</i> Gowdard's Fritillary	PE/SL	Open oak woodland/ shrubland	1
<i>Lewisia oregonensis</i> var. <i>howellii</i> Siskiyou Lewisia	SOC BSO	Rock outcrops	1

Species	Status	Habitat Requirement	Number of Sites
<i>Lonicera interrupta</i> Chaparral honeysuckle	BTO	Shrubland dry thickets	1
<i>Sedum radicans</i> ssp. <i>depaeportum</i> Depaeportia stonecrop	SOC BSO	Gravelly slopes and open forest floor	1
<i>Sedum laevis</i> ssp. <i>heckeri</i> Heckner's stonecrop	BTO	Rock outcrops	1
<i>Sedum obtusacolum</i> Applegate stonecrop	SOC BSO	Rocky slopes	6

The distribution and viability of these eight species is different for each species in the Applegate-Star/Boaz Watershed Analysis Area. This analysis area is an important part of the range for all the listed species and significant in maintaining their viability.

Cypripedium fasciculatum has small disjunct populations in Washington, Oregon, northern California, and a few scattered sites in the Rocky Mountains. *C. fasciculatum*'s center of distribution appears to be in southwestern Oregon and northern California with the Applegate River Subbasin being the key watershed with the most sites. A population at Alexander Gulch is one of the largest sites of this species on the district. The species occurs on north aspects with 60 to 90 percent canopy closure in mature and old-growth forests.

Cypripedium montanum also has a broad range in the Pacific Northwest but occurs in very small disjunct sites within its range. It has similar habitat requirements as *Cypripedium fasciculatum* and is found in upper Star Gulch. These *Cypripediums* were found to be at risk under all alternatives in the Northwest Forest Plan (USDA and USDI 1994a).

Fritillaria gentneri is a species associated with oak woodland and shrub fields. Its range is the Rogue Valley, but the major center of concentration is near the town of Jacksonville. The Star Gulch site, approximately 10 miles southwest of Jacksonville, is very important because most populations of this endemic species occur on private land and are at risk. Its habitat is being eradicated for building sites and other domestic uses. The U.S. Fish and Wildlife Service has proposed *F. gentneri* as endangered.

Lewisia cotyledon var. *howellii*, is another Siskiyou endemic for which the Applegate River Subbasin is an important part of its range. It is found on rock outcrops east of the Applegate River below Boaz Mountain.

Lonicera interrupta occurs on dry ridges and shrub fields east of the Applegate River. This species is at the north end of its range in the Applegate River Subbasin. Populations of species at the margins of their range are very important because that is where the greatest amount of genetic diversity occurs. The area is currently not significant for maintaining viability at this time, but could be for the long term.

Sedum radiatum ssp. *depauperatum* is found in upper Star Gulch on the forest floor and gravelly slopes. Inventories have shown this species to be more common than previously thought.

Sedum laxum ssp. *heckneri* is found only in the Applegate River Subbasin and is located in the upper Star Gulch growing on rock outcrops and rocky slopes.

Sedum obalanceolatum, known as the Applegate stonecrop, has a very narrow range of which Star Gulch is a major part. It occurs in rock outcrops and on rocky south facing slopes.

Survey and Manage Plant Species and Habitats

Fungi, bryophytes, lichens, and vascular plants all have species categorized by the Northwest Forest Plan as Survey and Manage. These are species to be protected through survey and management standards and guidelines, which are currently being developed. The four survey strategies found in the Record of Decision (ROD) are: (1) manage known sites, (2) survey prior to activities and manage sites, (3) conduct extensive surveys and manage sites, and (4) conduct general regional survey (USDA and USDI 1994a). At this time, there are 12 Survey and Manage species in the analysis area (Table 6).

Table 6. Survey and Manage Plant Species

Species	Plant Type	ROD Survey Strategy
<i>Cypripedium fasciculatum</i>	Vascular	1 & 2
<i>Cypripedium Montanum</i>	Vascular	1 & 2
<i>Phytocoris ericetorum</i>	Fungus	3 & 4
<i>Cantharellus subuloides</i>	Fungus	3 & 4
<i>Phlogotis helvelloides</i>	Fungus	3 & 4
<i>Colluma nigrescens</i>	Lichen	4
<i>Lebaria pulmonaria</i>	Lichen	4
<i>Nephroma ruscipitum</i>	Lichen	4
<i>Pubigera collina</i>	Lichen	4
<i>Pseudocyphellaria anomala</i>	Lichen	4
<i>Pseudocyphellaria austroripis</i>	Lichen	4
<i>Antitrichia curtipendula</i>	Bryophyte	4

Fungi are neither plant nor animal but recognized as a separate kingdom of organisms. Fungi have a close association with vascular plants. These organisms are very important to forest health in helping seedling establishment and nutrient uptake. The survival of most conifers and many flowering plants depends on their association with these mycorrhizal fungi (USDA

et al. 1993). The two Survey and Manage species of *Cypripedium* are thought to be dependent upon a mycorrhizal association for germination of their seed and existence of the mature plant.

Fungi also serve as an important food source for many animal species. A survey for fungi was conducted in the winter of 1997/1998. Thirty (30) species of fungi were identified. Three species are Survey and Manage strategy 3 & 4 (conduct extensive surveys and manage sites, and conduct general regional survey) (Table 6).

Bryophytes are made up of hornworts, liverworts, and mosses. Bryophytes are involved with nutrient cycles in forest stands. They intercept, absorb, and buffer nutrients and water in the canopy and understory. Bryophytes play an important role in the dynamics of understory vegetation, as well as soil structure, soil stability, and interception and retention of water. Many liverworts are mycorrhizal and are generally limited to decaying wood. Bryophytes are generally well developed in riparian areas and are major components of the forest stream ecosystem, providing year-round habitat for a wide array of aquatic invertebrates and amphibians (USDA et al. 1993).

An inventory was conducted for bryophytes in the Applegate-Star/Boaz Watershed Analysis Area in the fall and winter of 1997/1998. Thirty-five (35) species of bryophytes were identified. One species is Survey and Manage strategy 4 (conduct general regional survey) (Table 6). An inventory in the Little Applegate River Watershed found 136 bryophytes (37 liverworts and 99 mosses). Survey and Manage species found included two bryophytes: a moss and a liverwort. The moss, *Antitrichia curtipendula*, and the liverwort, *Placidium californicum* (California Survey and Manage species), were both found growing on bark in pure Douglas-fir stands.

Lichens are a special type of symbiotic association between a fungus and alga or cyanobacteria (blue-green algae) that form an organism with its own distinct characteristics. They absorb nutrients and moisture for growth from precipitation and atmospheric gases. Lichens are primary producers, accumulating biomass and carbohydrates, and contributing to forest nutrient cycling. Many lichens fix atmospheric nitrogen. Their litterfall provides organic material and increases the soil moisture holding capacity. The forage lichens are a food source for animals, such as flying squirrels, red-backed voles, and woodrats. Lichens are good biological indicators of air quality, important as indicators for determining the bankfull stage of streams, and provide habitat and food for canopy-dwelling invertebrates.

A lichen survey was conducted in the Applegate-Star/Boaz Watershed Analysis Area in the fall and winter of 1997/1998. Thirty-five (35) species of lichens were identified. Four of the species are Survey and Manage Strategy 4 (conduct general regional survey) (Table 6). An inventory in the adjacent Little Applegate River Watershed reported 110 species of lichens; of these, 7 are Survey and Manage species, 6 are epiphytic nitrogen-fixing lichens, and 5 are ROD strategy 4 (conduct general regional survey). *Usnea hesperia* is a ROD strategy 1 and 3 (manage known sites and conduct extensive surveys and manage sites) and was found on a Douglas-fir in a Douglas-fir stand. The other five species of lichens are ROD strategy 4 (conduct general regional survey). They were found predominately on hardwoods, including *Quercus kelloggii*, *Acer macrophyllum*, *Philadelphus*, the base of *Arbutus menziesii*, and *Taxus brevifolia*.

Two vascular plant Survey and Manage species, *Cypripedium fasciculatum* and *Cypripedium montanum*, occur in the watershed; they are Survey and Manage strategy 1 and 2 (manage known sites, and survey prior to activities and manage sites). See Special Status Plant Species and Habitats for a description.

Noxious Weeds

Noxious weeds as defined by the Oregon State Weed Board are "[Those plants] which are injurious to public health, agriculture, recreation, wildlife, or any public or private property." They have been declared a menace to public welfare (ORS 570.505) (ODA 1995).

The Applegate-Star/Boaz Watershed Analysis Area was surveyed for noxious weeds in 1995 (Budea 1995). Results of the survey showed bull thistle (*Cirsium vulgare*) and yellow starthistle (*Centaurea solstitialis*) distributed throughout the watershed; these were the only noxious weed species found on the Oregon Department of Agriculture's target list. However, there are 12 species known to occur within the Applegate River Subbasin (USDA and USDI 1995). It is possible that several more species could become established in the near future.

FIRE

Fire is recognized as a key natural disturbance process throughout the Klamath Geologic Province. The combination of climate and topography has created a fire regime pattern of frequent, widespread fires. Fire regime is a broad term that includes fire type and intensity, size, and return interval. Fire regimes are a function of the growing environment, ignition pattern, and plant characteristics. The fire regime for the Applegate-Star/Boaz Watershed Analysis Area, as with most of the interior valleys of southwest Oregon, is a low-severity regime. This regime is characterized by continual dry summers. This type of fire regime is frequent (1 to 25 years) and widespread with little effects to the overstory. Due to the frequency of fires, this limits the time for fuel to accumulate and therefore, fire intensity is usually moderate to low.

TERRESTRIAL WILDLIFE SPECIES AND HABITATS

The Applegate-Star/Boaz Watershed Analysis Area is typical of other low to mid-elevation portions of the Applegate River Subbasin. The bottomlands are characterized by riparian vegetation along the Applegate River, and agricultural lands or rural residences predominate from the edge of the riparian area to the hillslopes. Mixed conifer, oak woodland, mountain shrubland, and dry grassland plant communities dominate the south and west-facing slopes of the hillslopes, and mixed conifer forest dominates the more northerly and easterly aspects. The Vegetation section describes the various plant associations and condition classes that constitute the terrestrial wildlife habitats found in the analysis area. Refer to that section for a detailed description of these plant associations and condition classes and their relative abundance in the analysis area.

Terrestrial wildlife habitat conditions in the Applegate-Star/Boaz Watershed Analysis Area are similar to those found elsewhere in the mid-elevations of the Applegate River Subbasin; the number of species present are also similar. Approximately 200+ species use habitat in the analysis area for breeding, feeding, or sheltering.

Three pairs of northern spotted owls, a species listed as threatened under the guidelines of the Endangered Species Act of 1973, as amended, are present in the analysis area. Bald eagles, also a threatened species, probably forage at times along that portion of the Applegate River that passes through the analysis area.

Nearly 11,300 acres (64 percent) of the analysis area are in northern spotted owl critical habitat. Of these acres, approximately 10,500 acres are in Critical Habitat Units (CHU) OR-74 and approximately 800 acres are in OR-75.

Eight species recognized as Survey and Manage and/or Protection Buffer species in the Northwest Forest Plan are present or could be present in the Applegate-Star/Boaz Watershed Analysis Area. The red tree vole and Siskiyou Mountains salamander and great gray owl are known to be present. Based on information provided in the Draft Protocol for survey of terrestrial molluscs, five species could be present in the analysis area.

Twenty-one special status species (three reptiles, two amphibians, ten birds, and six mammals) are known or suspected to be present in the analysis area. These species are either federally listed as threatened or are designated as BLM sensitive or assessment species.

HYDROLOGY

For purposes of the hydrology discussion, the Applegate-Star/Boaz Watershed Analysis Area is stratified into two areas, Star Gulch and the Applegate River frontals. Star Gulch is subdivided into 19 drainage areas and the Applegate River frontals consists of 3 drainage areas, which include the Applegate River and Boaz Gulch (Map 10).

Groundwater

Groundwater supplies in the Applegate-Star/Boaz Watershed Analysis Area are limited and primarily found in valley bottom alluvium of the Applegate River corridor. This area has not been identified as a critical groundwater area by the Oregon Water Resources Department (OWRD 1989).

Surface Water

Surface water in the Applegate-Star/Boaz Watershed Analysis Area includes: streams, wetlands, reservoirs, and ditches. There are no natural ponds or lakes within the analysis area. Two palustrine (marsh) wetlands are identified by the U.S. Fish and Wildlife Service in their 1984 National Wetlands Inventory along the Applegate River on private land. Wetlands in the National Wetlands Inventory by definition were large enough to be seen on 1974 aerial

photographs. Additional wetlands may be located during site-specific project analysis.

There are 201.7 stream miles in the Applegate-Star/Boaz Watershed Analysis Area (Map 10). These include 14.8 miles of fish-bearing streams and approximately 186.9 miles of permanently flowing nonfish-bearing and intermittent streams. Inventory of nonfish-bearing streams has not been conducted to determine whether they are permanently flowing or intermittent. Miles of stream by stream order for Star Gulch and the Applegate River frontals are shown in Table 7. First and second order streams comprise 77 percent of the total stream miles.

Table 7. Stream Miles by Stream Order

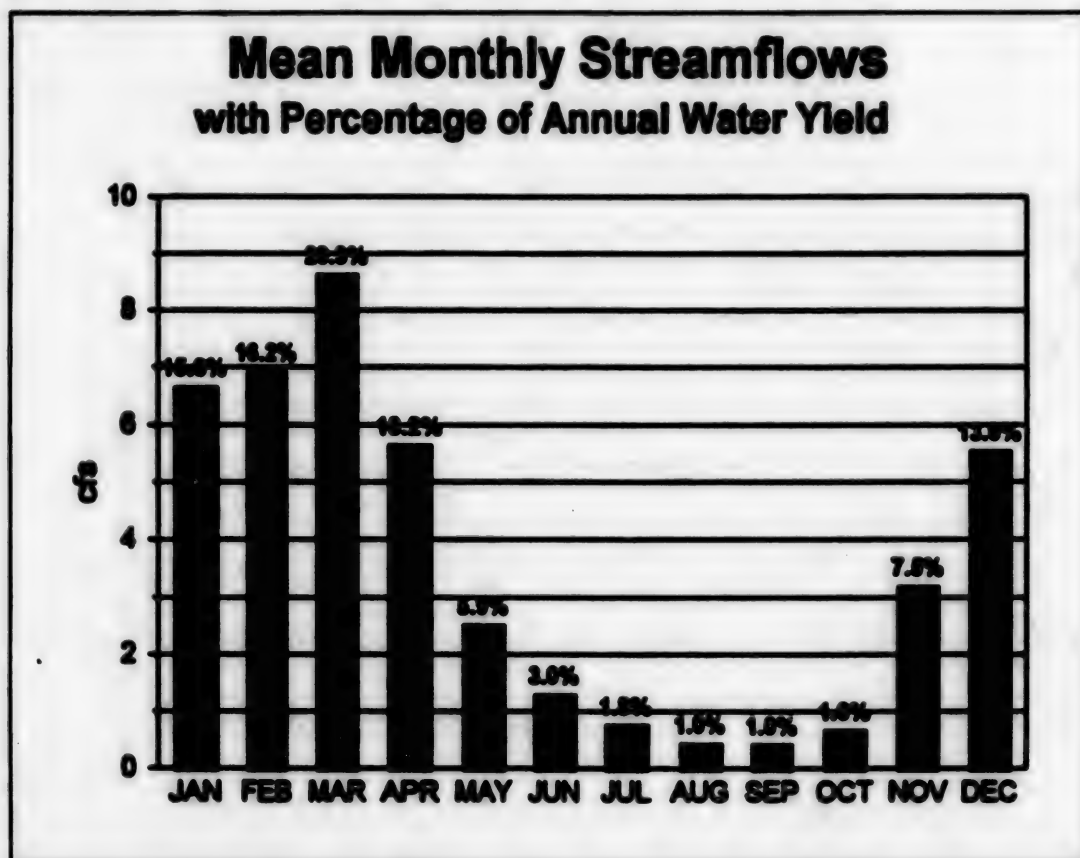
Watershed Area	Miles of Stream by Stream Order								Total
	1	2	3	4	5	6	7	8	
Star Gulch	68.3	26.3	14.4	5.7	5.5	0	0	0	120.2
Applegate Frontals	41.4	19.1	10.9	5.0	0	0	0	5.1	81.5
Totals	109.7	45.4	25.3	10.7	5.5	0	0	5.1	201.7

Sources: Medford BLM GIS

Streamflow

The Star Gulch United States Geological Survey (USGS) gaging station is located approximately one mile upstream from the mouth and provides nonregulated streamflow information for Applegate-Star/Boaz Watershed Analysis Area. The USGS gaging station near Copper (below the Applegate Dam) has collected pre- and post dam streamflow information for the Applegate River. Hydrographs developed for Star Gulch and the Applegate River show the average monthly streamflow distribution (Figures 3 and 4).

Figure 3. Streamflows for Star Gulch and Mean Monthly Percentage of Annual Water Yield

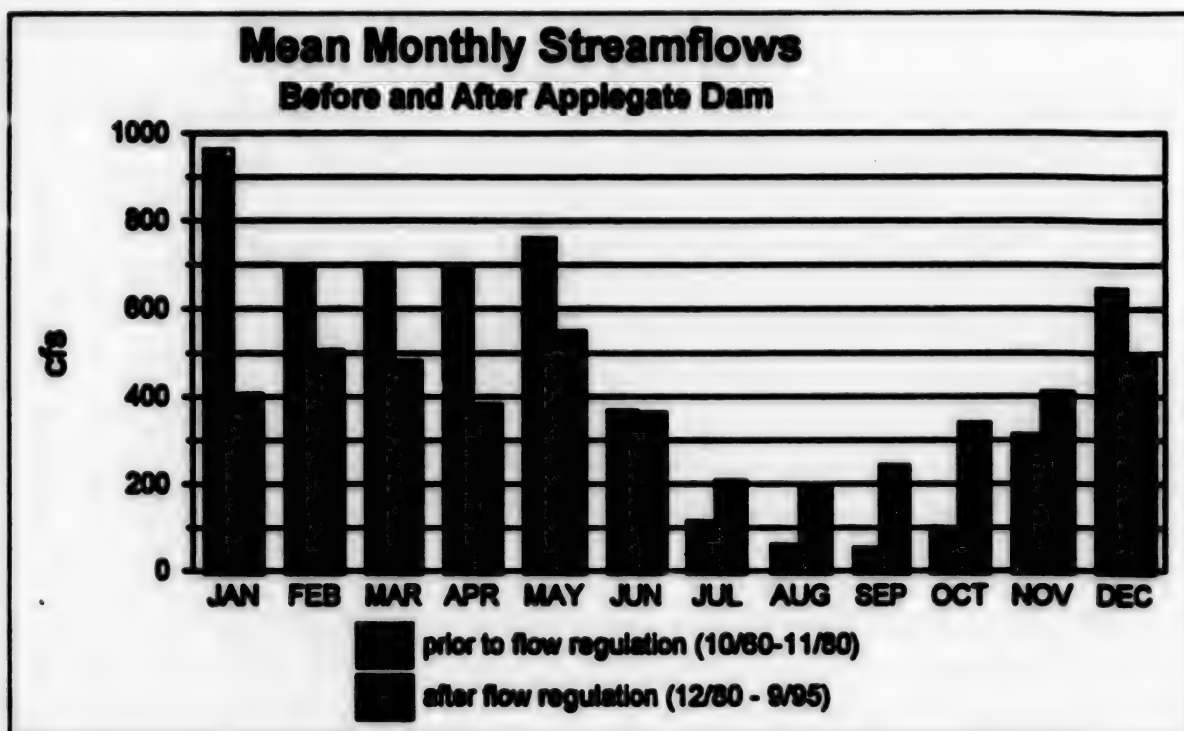


Source: U.S. Geological Survey Water Resources Data - Oregon (1983-1995)

Streamflow in the Applegate-Star/Boaz Watershed Analysis Area fluctuates with seasonal variation in precipitation. In Star Gulch, 86 percent of the annual water yield occurs from November through April. Runoff usually peaks in March and low flows generally occur from August through September or October.

Prior to the construction of the Applegate Dam, 66 percent of the annual water yield in the Applegate River near Copper occurred from December to May, runoff peaked in January, and low flows occurred in the Applegate River from July through October. After flow regulations, 50 percent of the annual water yield in the Applegate River near Copper occurs from December to May. Dam construction moderated peak flows. The highest runoff occurs in May after the reservoir has been nearly filled. The Applegate Dam resulted in increased summer flows.

Figure 4. Streamflows for Applegate River near Copper Below Applegate Dam (Before and After flow regulation by Applegate Dam)



Source: U.S. Geological Survey Water Resources Data - Oregon (1960 - 1995)

Appendix A (Table A1) shows the annual mean discharge, instantaneous maximum discharge, and instantaneous minimum discharge for the years of record (through water year 1997) at the Star Gulch and Applegate near Copper gaging stations. The highest instantaneous peak flows in the Applegate River during the record period were 29,000 cubic feet per second (cfs) in 1964 (1965 water year) and 29,800 cfs in 1974. The highest instantaneous peak flow in Star Gulch during the record period was 1,050 cfs in 1997. For a period of time during eight of the past 11 summers (through water year 1997), Star Gulch has not had continuous surface flow.

STREAM CHANNEL

The stream network in the Applegate-Star/Boaz Watershed Analysis Area is predominantly characterized by steep slopes, incised channels, and short stream lengths. The small tributary drainage areas respond fairly rapidly to storm events and water is quickly moved to downstream reaches. Drainage densities in the Applegate-Star/Boaz Watershed Analysis Area range from 4.3 to 10.0 mi./mi² (an average of 7.1 mi./mi² in Star Gulch and 7.7 mi./mi² in the Applegate River frontals). Higher drainage densities reflect greater intensity of channel incision and efficiency of basin drainage and erosion.

Rosen's stream classification system (1994) was used to categorize channel morphology

characteristics for the major drainages. Stream categories are based on stream gradients, sinuosity, valley form, entrenchment, and confinement (Rosgen 1994). These stream characteristics were obtained from 7.5 minute USGS topographic maps and aerial photographs.

Star Gulch tributaries and the other Applegate River tributaries within the analysis area have similar stream morphology characteristics. The upper reaches have very steep stream gradients (10 percent and greater) with frequently spaced vertical drop/scour-pool bed features (Rosgen type Aa+). They have straight, narrow, deeply entrenched, and confined channels. The lower reaches of the major tributaries have steep stream gradients (4 to 9.9 percent) with step/pool bed features (Rosgen type A). They are entrenched and confined with a low width/depth ratio.

The lower portion of Star Gulch (from the mouth to 1918 Gulch) has a moderate stream gradient (3.2 to 3.7 percent) and is moderately entrenched and riffle dominated with infrequently spaced pools (Rosgen type B). It has stable banks within a narrow, gently sloping valley. The lower channel reaches are confined by rock berms that were constructed during mining activities in the 1850s.

The portion of the Applegate River flowing through the analysis area is entrenched and disassociated from the adjacent floodplain due to the channel being confined by a road on each side (Rosgen type F). The valley bottom ranges from approximately 600 to 2,000 feet across. The narrowest point is where Star Gulch enters the Applegate River and constricting ridges confine the valley bottom.

Most of the sediment generated in headwater streams is transported out of the steep, high energy, tributary channels and into the lower gradient main channels where it is deposited. During high flows, deposited material can be moved farther downstream where it is redeposited until the next high water event moves it.

WATER QUALITY

Beneficial uses that are dependent on aquatic resources in the Applegate-Star/Boaz Watershed Analysis Area include: domestic water supply, irrigation, livestock watering, cold water fish, other aquatic life, wildlife, recreation, and aesthetics (ODEQ 1992). The designation of beneficial uses is important since it determines the water quality criteria that will be applied to that water body. Temperature, pH, dissolved oxygen, sedimentation, and turbidity are the water quality parameters in the Applegate-Star/Boaz Watershed Analysis Area that are most critical to these beneficial uses.

RIPARIAN AREAS

Riparian areas provide a cool, moist refuge, especially important during southern Oregon's hot summers. The riparian plant community usually differs from those found in the uplands. North-facing drainages on permanently-flowing streams have wide riparian areas with a variety

of trees, shrubs, forbs, and non-vascular plants (e.g., mosses and liverworts). South-facing areas on intermittent streams generally have narrow riparian areas often with upland species, such as oak mixed in with riparian-dependant species (e.g., maple). Some intermittent or ephemeral streams in south-facing brushlands, for example, have little typical "riparian vegetation;" this is due to shallow soils, lack of moisture, and intense sunlight in the summer months. Other intermittent or ephemeral streams on north-facing drainages also have little typical "riparian vegetation," and the reasons for this are less clear.

Aspect, valley shape, and stream type (perennial, intermittent, ephemeral) all partially determine the amount and species composition of riparian vegetation. Fire has also played an important role in vegetation composition. Before fire suppression changed the forest structure, cool, underburning fires could have burned through portions of riparian areas, especially on south-facing slopes. It is possible that the riparian plant communities of today are substantially different in these areas. However, logging, mining, roads, grazing, agriculture, and settlement have been the primary forces affecting riparian areas along all of the streams in the Applegate-Star/Boaz Watershed Analysis Area.

Riparian-dependent wildlife species in the watershed include: amphibians, kingfishers, herons, waterfowl, and neotropical migrating birds. Riparian areas that provide diverse habitat are mainly along Star Gulch and its perennial tributaries. The riparian area along the Applegate River is very narrow and steep and thereby provides minimal wildlife habitat. The riparian areas along the small intermittent and ephemeral upland tributaries vary in the amount and quality of habitat they provide.

AQUATIC WILDLIFE SPECIES AND HABITATS

Special Status Fishes

Two special status fishes, coho salmon (*Oncorhynchus kisutch*) and Klamath Mountains Province steelhead (*O. mykiss*), spawn and rear in the Applegate-Star/Boaz Watershed Analysis Area (Maps 11 and 12). The National Marine Fisheries Service (NMFS) listed coho salmon in the Rogue and Klamath river basins on June 6, 1997 as threatened under the Endangered Species Act. The Klamath Mountains Province steelhead remain an official "candidate" species.

Other Native Fishes

Cutthroat (*O. clarki*) are present in the mainstem of the Applegate River, but are more prevalent in Star Gulch (Map 13). Cutthroat tend to inhabit smaller, steeper, colder streams. They probably spend their lives in Star Gulch, moving in and out of upstream headwaters to spawn. Some cutthroat may only use tributaries to spawn in during the spring, but spend the rest of their lives in the Applegate River.

Rainbow trout are the same species as steelhead (*O. mykiss*). Rainbow spend their whole lives in fresh water and they commonly migrate into tributaries to spawn. However, available

information indicates that the *O. mykiss* in Star Gulch are all steelhead. Rainbow trout are only present in the mainstem of the Applegate River (Map 14).

There are many other native species that may be present in the analysis area. These are not considered sport fish or consumed, and consequently have less commercial importance. For these reasons, very little information exists on the distribution and abundance of these species. Pacific lamprey (*Lampetra tridentata*), western brook lamprey (*L. richardsoni*), reticulate sculpin (*Cottus perplexus*), and Klamath smallscale suckers (*Catostomus rivicolus*) are all native species present in the Applegate River system. Sculpin and lamprey have been found in Star Gulch (Arnold 1996).

Introduced Fishes

Redside shiners (*Richardsonius balteatus*), speckled dace (*Rhinichthys osculus*), and Umpqua squawfish (*Ptychocheilus umpqua*) are common throughout the Applegate River system. They were probably introduced inadvertently by anglers. Applegate Lake and Squaw Lakes, upstream of the analysis area, have been stocked with largemouth bass (*Micropterus dolomieu*), smallmouth bass (*M. salmoides*), crappie (*Pomoxis* spp.), bluegill (*Lepomis macrochirus*), and other warmwater fishes. These fishes that are not native to the Applegate River system may be washed downstream during high flows. There is almost no information available on the distribution and abundance of these non-native fishes.

Aquatic Insects

Aquatic insects are extremely important in stream ecosystems. Among other functions, they turn leaves and wood into nutrients for fish and other aquatic animals. No sensitive or endangered aquatic insect taxa were found during a 1996 survey conducted in the Star Gulch drainage (Schroeder 1996). Surveys in the adjacent Little Applegate River Watershed found two caddisflies species, which may be *Philocasa oron*, the Clatsop philocasan caddisfly, and *Tinodes siskiyou*, the Siskiyou caddisfly (Wiseman 1995). Both species are considered "Species of Concern" (previously called "Category II") under the Endangered Species Act of 1973, as amended.

Amphibians

BLM fish surveys have encountered Pacific Giant Salamanders (*Dicamptodon ensatus*) in Star Gulch. They may be present in tributaries to Star Gulch, especially north-facing streams that have an abundance of canopy cover and large, mossy boulders. Aquatic garter snakes (*Thamnophis couchii*) have been found in Star Gulch and are probably common along the edges of the Applegate River.

Fish Habitat

Settlement and agricultural activities have had the biggest impact on the Applegate River. As farmers and ranchers cut off side channels and floodplains for pasture, water tables in adjacent riparian areas dropped. Once abundant side channel and complex alcove habitat, which are

important for young fish, have disappeared. The river has been straightened and channelized causing it to downcut. Channelization may have changed sediment distribution, possibly affecting the amount or stability of spawning gravels. In addition, both irrigation and the Applegate Dam have changed flood and summer low flows in the river (see Hydrology), which may have reduced the amount or quality of spawning gravels. Lack of river spawning and rearing areas put more pressure on a tributary, such as Star Gulch, to provide fish habitat. However, Star Gulch may not be a dependable fish production area due to its inconsistent flow at the mouth, lack of pools, and marginal spawning areas. Management activities, such as road building and logging, have reduced both the quantity and quality of fish habitat in Star Gulch.

Star Gulch appears to be recovering from past human uses. Improvement of fish habitat in the Applegate River depends on private landowners, federal land managers, and federal and state regulatory agencies working together.

Habitat for Aquatic Insects, Amphibians, and Other Aquatic-Dependent Wildlife Species

Information on the distribution of these groups is lacking, therefore, habitat can only be discussed in general terms. Where habitat has been lost, local populations have declined. Species that depend on wetlands and seasonally-wet areas in open, flat river-bottom areas are probably declining. Species that depend on regular flooding in a river system may have problems. Species that are adapted to seasonally-flowing streams are probably fine. Species that need pool habitat, large woody debris, or old-growth riparian areas in or along small streams have lost habitat in Star Gulch and may be declining.

CURRENT CONDITIONS

The purpose of the Current Conditions section is to develop information relevant to the identified Issues and Key Questions. The Current Conditions section provides more detail than the Characterization section and documents the current conditions and trends of the relevant ecosystem elements.

HUMAN USES

Native Americans

The native inhabitants of the Applegate-Star/Boaz Watershed Analysis Area, along with other native people in the region, were removed to the Siletz and Grand Ronde reservations in northern Oregon after the "Indian Wars" of 1851-1856. Today, many of their descendants are members of the Confederated Tribes of the Siletz and the Confederated Tribes of the Grand Ronde. Both tribes are federally recognized and are active in promoting the heritage and welfare of their members. As federally recognized tribes, the Siletz and Grand Ronde are accorded governmental status. The Siletz are also a "compact tribe," according to the Tribal Self-Governance Act of 1994 (PL103-413) and may assume responsibility for certain aspects of federal programs within the Department of the Interior. There are no reserved treaty or tribal rights in the analysis area.

Archaeological Sites

Several Native American sites and isolated finds are recorded within the analysis area; the most notable is the site at Star Ranger Station. There are also four historic sites recorded that relate to mining activities.

There has been only a limited systematic survey for archaeological remains within the analysis area. Historic and prehistoric (Native American) sites are likely to occur along the Applegate River and lower reaches of Star Gulch, as well as up the tributaries to these drainages and along the ridges of the analysis area boundaries. Mining remains, including several historic ditches and rock walls, occur throughout the analysis area; adits related to lode mining are reported in the upper reaches of Star Gulch.

Recreation

There are no developed recreation sites in the analysis area. Recreational use includes: dispersed camping, as well as activities such as hunting, fishing, mushroom picking, sight seeing, and mining.

Facilities and Structures

The Rogue River National Forest manages two facilities in T.39S., R.3W., Section 28. The Star Ranger Station is located on the Applegate River approximately 1/4-mile south of Star Gulch. An associated work station site is located along the Star Gulch road approximately 1/4-mile from the Applegate River Road. The work station site has been utilized over the years by the Forest Service for various purposes, including housing fire crews, a day care center, and the Americorp. The Oregon Department of Forestry operates a lookout tower located on Tallowbox Mountain (T.39S., R.4W., Section 11). The primary access is from the Cantrall road system to the northeast, which is outside of the analysis area. The lookout has been in service since 1923 and is still active today. A streamflow gaging station funded by BLM and operated by the United States Geological Survey since 1983 is located one mile up Star Gulch.

Authorized and Unauthorized Uses

The Bureau of Land Management (BLM) has issued five authorizations within the analysis area. Two rights-of-way for water lines are in sections that drain into the Applegate River. The other three authorizations are associated with the Tallowbox Mountain Lookout site: one is to the State of Oregon for the lookout tower and the other two are for communication repeaters.

There are two known unauthorized waterlines in the analysis area. They have been reported and files have been established; subsequent field work and follow-up needs to be completed prior to final disposition. Other unauthorized uses probably exist in the analysis area, such as garbage dumping, especially in those sections where private and federal lands are intermixed. Due to the large amount of contiguous federal ownership in this analysis area and small amount of rural interface, unauthorized use is not as common as compared to other watersheds with greater amounts of mixed ownership.

Special Designated Areas

The analysis area is within the Applegate Adaptive Management Area, and hence subject to the policies that affect lands within this land allocation.

The upper reach of Star Gulch is designated a control watershed for monitoring water quantity and quality (USDI 1995).

County zoning for the private parcels in the watershed are: Exclusive Farm Use (EFU); Forest Reserve, 160 acres (FR-160); Woodland Resources (WR); Rural Residential, 5 acre lots (RR-5); and Farm Residential, 5-acre lots (F-5). The F-5 designation was intended to act as a buffer for the EFU and other resource-based lands, however, this designation has not been very effective and may be dropped in the future. If this occurs, these parcels would probably become RR-5 zoning.

Special Forest Products

Fuelwood is the special forest product (SFP) with the largest volume removed from Star Gulch followed by Christmas trees and salvage sawtimber. Fuelwood removal probably peaked in the late 1970s through the middle 1980s when logging activity was high and use of woodstoves was also very high. Restrictions on wood burning in the Medford area, combined with decreasing timber sale activity, have resulted in a dramatic reduction in fuelwood cutting since the mid-1980s. Christmas tree cutting will continue in the watershed at a low level. BLM has utilized Star Gulch for many years as a source for individual family tree cutting. Currently, there is little interest for other SFPs in the analysis area, such as floral greenery, boughs, and mushrooms.

Logging

During the fall of 1987, a dry lightning storm moving through southern Oregon started a series of large stand replacement fires. The Star Gulch Fire left a blackened landscape on approximately 1,735 acres, of which 461 acres were salvaged logged with tractors and skyline systems.

During 1990 to 1992, the landscape showed evidence of available salvage from stand mortality by insects. Due to the low volume per acre and areas with few roads, helicopters were used for the majority of the salvage. Approximately 5,070 acres were salvage harvested during this time period.

Timber harvest on federal land other than salvage logging virtually halted in 1991 when the U.S. Fish and Wildlife Service listed the northern spotted owl as a threatened species under the Endangered Species Act of 1973, as amended. Logging has resumed under the 1994 Northwest Forest Plan using different types of harvest methods, such as commercial thinning, density management, and mortality salvage.

Grazing

The Applegate-Star/Boaz Watershed Analysis Area contains portions of three BLM-administered grazing allotments, as identified in the Medford District Grazing Management Program Environmental Impact Statement (USDI 1984) and subsequent Rangeland Program Summary updates (Map 15). Table 8 identifies these allotments and their current status.

Table 8. BLM-Administered Allotments

Name	Allotment Number	Total Acres	Status	Season of Use	Preference AUMs ¹
Applegate	20201	25,518	vacant	4/15-6/30	672
Louisa Road	20222	635	vacant	4/15-6/15	50
Lower Big Applegate	20206	11,752	active	4/16-6/30	298

¹/Animal Unit Months (AUMs)

The Lomas Road allotment includes the public lands within T.39S., R.3W., Section 9. The remaining lands west of the Applegate River are included within the Applegate allotment. All lands within the analysis area east of the Applegate River are included within the Lower Big Applegate allotment. As shown in Table 8, the Lower Big Applegate is the only active allotment. The allotment preference for the Lower Big Applegate is split between two operators, both of whom have their base operation within the Applegate-Star/Boaz Watershed Analysis Area along the Applegate River.

Lower Big Applegate Allotment has a trend for the Boaz Pasture at steady or slightly improving for range forage value and condition. Data come from two readings (1990 and 1995) of a nested frequency monitoring site in section 27 (T39S R3W). However, between the 1990 signing of the CRMP and the present, range science has re-defined "rangeland" to mean only non-transitory grazing land. The study site on Boaz Gulch is within a transitory (forested, logged), not perennial grazing land. (Perennial grazing land has to have a potential natural community of grass, or at highest, pine/oak type woodland.) There is no guarantee this site will be monitored in the future.

Current livestock utilization levels are consistently at or below moderate utilization on that portion of the Lower Big Applegate Allotment within the analysis area. Potential cooperative livestock related projects on private lands within the analysis area include fence and livestock watering projects in the Boaz Gulch areas.

Mining Claims

BLM records show there are approximately 30 valid lode claims and 9 valid placer claims within the Star Gulch area. There are three known "Notice of Intent" filings for the various mining claims located within the Star Gulch portion of the analysis area. A Notice of Intent is a written notice to the BLM for a small scale mining activity. The mining activity cannot exceed five acres of ground disturbance in any one year.

Social Conditions and Issues

The Applegate-Star/Boaz Watershed Analysis Area falls within the Upper Applegate neighborhood (Priester 1994). People living within this area made their living from ranching, farming, mining, and logging for much of this century. After World War II, improved roads and difficulties in the traditional occupations led to an increase in commuters—people who live in the area, but make their living in the more urbanized parts of the Rogue Valley (Priester 1994).

The post-war decades have also witnessed a population boom. People moving to the area in the 1960-70s are now in positions of local leadership and represent a sizeable portion of the population. A greater proportion of immigrants in the 1980s have been retired people who have not been so readily absorbed. During the last few years, there has been a trend in the construction of large homes with fences, which was not typical of earlier homes (Priester 1994).

Growth and in-migration have placed strains upon the local society and the issues that revolve around the problems of a small community, such as the division between new-comers and the established locals, lack of local involvement, and the need for a community center. Other issues of interest include the problem and fear of forest fires and escalating real-estate prices (Priester 1994).

The Applegate Partnership was formed by individuals, community groups, and residents of the Applegate area to address the concerns for the Applegate River Subbasin, which includes the Applegate-Star/Boaz Watershed Analysis Area. This partnership provides a forum for discussing local issues and exchanging information among the various interests in the region.

Current Human Uses and Trends

Federal personnel and local landowners are most closely associated with the analysis area. Issues important to federal land management policy, such as ecosystem management and adaptive management, will continue to have a direct effect on the lands in the analysis area. Issues important to private landowners, such as development and the increase in local residents, will continue to affect private and public land issues.

Ranching, farming, timber harvesting, and employment of public and private forestry personnel contribute to the local and regional economy. Some mining continues in Star Gulch, although it is at a very small scale.

ROADS

BLM's Geographical Information System (GIS) and Transportation Information Management System (TIMS) identify approximately 90 miles of road within the analysis area (Map 16), of which 69 percent are controlled by BLM. Roads in the analysis area vary from primitive four-wheel drive roads to paved highways. The major access roads are located on flatter areas along the Applegate River and Star Gulch. BLM-controlled roads consist of approximately 43 miles of natural surface roads, 35 miles of rocky roads, and 13 miles of bituminous surface treatment (BST) roads. BLM's goal is to maintain its transportation system in a safe and environmentally sound condition. The result is a transportation system that provides for various recreational activities, private access, logging, fire fighting access, and other land management uses. BLM's inventory contains very little information about non-BLM-controlled roads. Most county roads have a bituminous surface and private roads are usually either rocky or unsurfaced.

Road densities in the analysis area are highest on BLM lands in Alexander Gulch, Lightning Gulch, and Benson Gulch (Appendix A, Table A2). There is also a high road density on private lands along the Applegate River. Road density is lower on the north side of Star Gulch and the east side of the Applegate River (see Erosion Processes and Hydrology sections for more information on road density).

All BLM-controlled roads have a maintenance level assigned to them. The roads are

monitored and the maintenance levels are modified when needs and conditions change. Maintenance levels range from minimal standards on short roads to high standards on main roads. The transportation system in this watershed is generally stable and does not require a high maintenance level. BLM road maintenance is partially funded by fees charged for commercial use of BLM-controlled roads. A reduction in timber harvest levels has resulted in a significant decrease in the primary funding source for maintaining the BLM transportation system. Many roads previously maintained at a high level are not being maintained to that extent any longer. To reduce maintenance requirements and erosion potential, some roads have been or will be decommissioned. Other roads are closed until future access is needed; many others are maintained at the lowest possible levels. Sharing and maintaining roads with landowners has also reduced access and maintenance costs.

Road maintenance includes reducing soil erosion potential and providing for fish passage at all potential fish-bearing stream crossings. Proper maintenance of road drainage systems and stream crossing culverts is essential to avoid both erosion and fish passage problems. Most of the existing culverts were designed to withstand 50-year flood events. New drainage structures will be designed to withstand a 100-year flood event and, when applicable, provide for fish passage (USDA and USDI 1994a). Erosion mitigation measures include: constructing drainage structures, grass seeding, blocking roads, and placing road surface rock and BST.

Road maintenance also includes removing safety hazards. Hazard trees next to forest roads are removed if they are a safety concern. Hazard trees are those trees that have the potential to fall into roadways. They are usually dead, but may be alive with roots under-cut or with significant physical damage to the trunk or root system.

BLM roads are generally open for public use unless blocked by gates or other methods. Gates and other road barriers regulate vehicle access to reduce maintenance costs, soil erosion, wildlife disturbance, and the transfer of noxious weeds. The BLM road inventory shows approximately four miles of BLM-controlled roads are located behind road blocks.

The BLM sometimes grants legal authorization for use of roads to individuals or timber companies who need long-term authorization for a specific need. BLM authorizes this type of right by means of a right-of-way grant. At this time, there are no right-of-way grants issued for use of BLM roads in this analysis area. Some roads in the analysis area have reciprocal road use agreements between the BLM and timber companies providing for a shared cost and use of specified roads. The BLM obtains easements for access across private properties.

EROSION PROCESSES

As described in the Watershed Characterization section, Erosion Processes, surface colluvial erosion or raveling is a dominant erosion process in the analysis area (Map 7). Where vegetation is intact, the rate of ravel movement down slope is inhibited by litter, rooted grasses, forbs, shrubs, and large tree trunks. Ravel material typically accumulates on bases of trees. Smaller fast growing plants, such as vines and ground-covering species, may inhibit ravel movement by establishment of root networks between particles. Coarse wood

accumulations also inhibit ravel movement, especially where aligned with the contour of the slope. Ravel movement rates and corresponding difference between bare slopes and vegetated slopes have not been quantified. Where movement rates are high and/or ravel thickness is great (approximately greater than six inches), establishment of tree seedlings or other vegetation becomes difficult.

Where plant communities have been partially or totally eliminated, ravel movement rates increase and ravel thickness may increase. High intensity fires, clearcuts, and road construction are the most prevalent forms of major disturbance in the analysis area that have affected plant communities, thus increasing the ravel movement rate. Vegetative recovery should continue, as long as high levels of surface or vegetation disturbance do not occur.

The other dominant form of erosion is concentrated water flow expressed in the form of rills and/or gullies. Areas of high erosion hazard rating are illustrated on Map 7. The rating displays susceptibility to the concentrated flow form of erosion in bare soil conditions. If vegetated cover is maintained, erosion is usually not evident. Erosion from concentrated flow is increased by road construction through the interception of subsurface flow and a very slowly permeable road surface. Areas of high road density are in Benson, Lightning, and Alexander gulches. Though portions of these areas are not in the high erosion hazard categories, the artificially concentrated flow may cause eroded sites particularly at culvert outfalls and water bar/dip outlets.

SOIL PRODUCTIVITY

The "intrinsic forest soil productivity" ratings for the soils in the analysis area are shown on Map 8. These ratings are relative to one another and based on Natural Resources Conservation Service site index indicated for each soil map unit (USDA 1993). These are "intrinsic" because they reflect long-term soil properties, such as rooting depth, drainage, density, cation exchange capacity, and site characteristics, such as aspect and climate.

Though not quantified, reduction in current productivity can be due to loss of duff, litter, and coarse woody material during intense wildfires and forestry practices (see Watershed Characterization, Erosion Processes). Within the last ten years, intensive logging has occurred in high road density areas. These areas may have incurred reductions in forest productivity, but when compared to the life cycles of the forests, the reductions may not be significant.

Areas subject to intense fire are more likely to experience noticeable reductions in forest productivity as evident in the area burned by the 1987 Star Gulch Fire. Map 21 shows units that were more than 70 percent intensely burned and salvage logged after the fire. An intense fire consumed the duff, litter, and most of the coarse woody material. This extensive reduction of organic matter, which is the "nutrient rich" portion of the soil, may have significantly reduced long-term productivity. Intense fire reduces the organic matter's influences on important physical characteristics, such as reducing bulk density and adding "glues" through processing by soil microbes, which help maintain and stabilize natural aggradation (Amaranthus 1989). Without organic matter, a long-term rebuilding process must

take place in order to regain lost productivity.

Much of the Star Gulch Fire occurred on Caris-Offenbacher soils that have a very limited capacity for growing trees. There is a delicate balance of organic matter in and on these soils that maintains the productivity level. Unless there is a reduction in the fuel component, wildfire will cause a downward trend in soil productivity. Reduction of fire hazard through management practices will help to maintain and/or improve productivity on southerly aspects.

Unmanaged forest stands examined in parts of the Middle Applegate Watershed that are similar to those in the Applegate-Star/Boaz Watershed Analysis Area have less coarse wood than the amount referred to in the Northwest Forest Plan as a minimum needed for healthy forests. It is not clear whether this is truly a deficiency or if the Northwest Forest Plan simply does not reflect growing conditions in the lower elevations of the Applegate Valley.

VEGETATION DENSITY AND VIGOR

Tree Series/Plant Association

As a result of the recent drought conditions, there is evidence of moisture stress on some of the more productive sites. Mortality is occurring in stands that have more trees than the site can support. In the PSME (Douglas-fir)/ABCO (white fir)/HODI (creambrush oceanspray) association, white fir is dying at low elevations where it cannot compete with the other tree species for limited moisture. The harshest sites have white oak associations and the PSME (Douglas-fir)/QUGA (Oregon white oak), PSME (Douglas-fir)/CECU (wedgeloaf ceanothus), PSME (Douglas-fir)/RHDI (poison oak)/CYGR (Pacific hounds tooth), PSME (Douglas-fir)/RHDI (poison oak), and PSME (Douglas-fir)/RHDI (poison oak)-BEPI (Pipers Oregon grape) plant associations. Conifer mortality is evident in these associations, especially Douglas-fir. Ponderosa pine has died where dense vegetation is present and soil moisture is severely limiting. These sites are prone to insect and disease problems.

Vegetation in all condition classes (including shrublands and woodlands) tends to be late seral because of a lack of natural disturbance, such as wildland fires, insects, and disease. Late seral stage refers to the stage in development where mortality and snag formation lead to a more diverse, mature forest structure with a developing understory (McKinley and Frank 1996). (Note: The seral stages referred to in this document should not be confused with BLM vegetation condition classes.) Shrublands and oak woodlands have vegetation over 100 years old. Douglas-fir is the climax tree species in early pole, mid- and mature/old-growth condition classes. In the oak woodlands, the oak species will be climax. If early seral plants are present, it is usually the result of a small scale disturbance (e.g., landslide, fire, blowdown). The grass, forb, herbaceous, and early seedling/sapling condition classes can be thought of as early seral in development (Table 3, Watershed Characterization).

Stand Development Processes

After a disturbance, forest lands progress through four distinct stages: stand initiation, stem exclusion, understory reinitiation, and old-growth (Oliver and Larson 1990). After a disturbance, the stand initiation stage begins. During this period, which may last several years, new individuals and species enter the stand. It may take several decades for a given stand to make the transition from the stand initiation stage to the stem exclusion stage. The stem exclusion stage occurs when the growing space is fully occupied, preventing new individuals from invading the site and causing some of the existing vegetation to die. This stage has the fewest plant species. The understory reinitiation stage is entered when new species and individuals begin to grow in the understory. As overstory trees die, trees from the forest floor established during the understory reinitiation stage slowly grow into the overstory. When all of the trees that became established from the initial disturbance die, the stand enters the true old-growth condition (Oliver and Larson 1990).

A large percentage of the forest stands in the analysis area are in the stem exclusion stage. Canyon live oak, whiteleaf manzanita, shrubs, and herbaceous species are present in the understory. There is very little natural conifer tree regeneration in the understory. These timber stands probably had one to 4,000 stems per acre at the stand initiation stage. They have never been precommercially thinned and are nearing the end of the stem exclusion stage. Many of the older Douglas-fir stands in the analysis area are in the understory reinitiation stage. Many of the large, older trees have died leaving space that is now being filled with Douglas-fir seedlings.

Species composition shifts are evident since forest stand establishment. Suppressed shrubs and hardwood trees are dying in large pole stands 11 to 21 inches diameter at breast height (dbh). Hardwood and shrub species, such as large and small diameter Pacific madrone, white and black oak trees, whiteleaf manzanita, creambrush oceanspray, serviceberry, deerbrush and wedgeleaf ceanothus are being lost in the understory because of the lack of sun light. Douglas-fir has managed to dominate ponderosa pine and knobcone pine on some sites where pine is better adapted physiologically. Mature trees 30 inches dbh and larger and at least 150 years of age are dying because of competition for moisture with excessive trees beneath the drip line (outer edge of tree branches).

The absence of fire in the ecosystem, due to suppression efforts, has changed the species composition, structure, stocking rates, and perhaps nutrient cycling of the forest ecosystem. Successional shifts from shade intolerant pine species to Douglas-fir and some white fir in the higher elevations has occurred over the last 100 years. The pine species and incense cedar are also more fire resistant and drought tolerant than Douglas-fir and white fir. Present tree stocking rates are higher than historical levels because of less frequent understory fires. The combination of high tree stocking levels and drought conditions over the last 10 years has resulted in decreased tree vigor and accelerated bark beetle attacks.

Due to past fire suppression and logging practices, ponderosa pine, knobcone pine, and incense cedar stands are converting to Douglas-fir. The increase of Douglas-fir populations out-compete old-growth sugar pine pockets and lower elevation ponderosa pine found

throughout the analysis area. Knobcone pine have a serotinous cone, which requires fire to open them. Without the introduction of fire in the analysis area, the knobcone pine will likely be lost. White fir is migrating into the lower elevations and encroaching upon the Douglas-fir. The oak woodlands have been encroached upon by Douglas-fir, but many of the conifers within the oak woodland are dead or dying. Whiteleaf manzanita and ceanothus species are migrating into the oak woodlands and grasslands, replacing the oaks, pines, and native grass species.

Forest Ecosystem Disturbance Processes

Historically, fire and wind have been natural disturbances in the Applegate-Star/Boaz Watershed Analysis Area. Forest fires played a major role in shaping the landscape by influencing species composition and soil site productivity. Fire effects include: killing/scarring or weakening trees, burning surface organic matter, decomposition and nutrient availability, opening serotinous cones, creating a hospitable environment for seed germination (fire cherry, fireweed, *Ceanothus*, and ponderosa pine), and providing open spaces that favor establishment of shade intolerant species such as pine. Fire suppression since the early 1900s has resulted in overstocked stands, allowed Douglas-fir to replace pine species, and possibly delayed the release of nutrients in the soil. Fire suppression has contributed to the increase of natural fuels within the forest stands and this factor may result in future fires that are stand-replacing in nature. The 1967 Star Gulch Fire, which burned 1,735 acres, is an example of a very hot, stand-replacement fire.

Windstorms have played a role in shaping the landscape pattern. Winds may uproot and overturn trees, snap tree branches, or break trees at the main stem. Frequently, affected trees are exposed due to adjacent timber cutting or a large stand replacement fire. Forest stands that have been thinned are also subject to wind damage, if too many trees are removed, because the remaining trees are no longer supported by surrounding trees. The openings in the forest canopy layer that result from windthrow create growing space that may shift the stand development pattern to the understory reinitiation stage. The overturned trees create bare soil conditions, providing suitable conditions for natural regeneration, such as dispersal of seeds.

Forest pathogens play a significant role in altering the vertical forest stand structure, providing wildlife habitat, and in forming the landscape pattern of the analysis area. The most common pathogens are *Phellinus pini* (red ring rot) and *Arceuthobium douglasii* (Douglas-fir dwarf mistletoe). Red ring rot is prevalent on harsh sites with high stocking levels and causes stem rot and subjects the infected trees to wind damage. Infection of dwarf mistletoe causes growth loss, wood quality reduction, and top killing, eventually killing the tree. Other root diseases that may be present are: *Fomes annosus*, *Armillaria ostoyae*, and *Phellinus weirii*, and *Phaeolus schweinitzii* (velvet top), another stem rot.

Disporia loboyae may be present in conifer plantations located on dry, harsh sites. Damage usually occurs in small patches and is an indication that the trees are experiencing water stress. This fungus will usually occur after two or three years of drought and may serve to naturally thin overstocked stands that would otherwise require precommercial thinning. Black stain root disease (*Ceratocystis wageneri*) probably occurs in the Applegate-Star/Boaz Watershed

Analysis Area and could cause tree mortality in 15- to 25-year old plantations.

Bark beetle infestations are a primary cause of mortality in stands throughout the analysis area. Mountain pine beetles (*Dendroctonus ponderosae*), western pine beetles (*Dendroctonus brevicornis*) and pine engraver beetles (*Ips*, spp.) attack the pine species. Flatheaded fir borers (*Melanophila drummondii*) and Douglas-fir beetles (*Dendroctonus pseudotsugae*) infest Douglas-fir. Fir engravers (*Scolytus ventralis*) select the true fir species.

Beetles prefer trees that are stressed by disease, injury, drought, or competition. Overstocked stands and the prevailing drought have increased the incidence of beetle kill. Large diameter old-growth and suppressed younger trees are likely targets for attack. When stand basal area exceeds 120-square feet per acre on drier sites or 140-square feet per acre on moister sites, the risk of beetle infestation is high (Goheen and Goheen 1995). The stands north of Star Gulch Road and east of the Applegate River with a south, east, or west aspect below elevations of 3,500 feet are at high risk. Logging practices may accelerate the occurrence of beetle infestation as populations can build up in slash piles. Trees that have been infected and weakened by another pathogen are primary targets for beetle attack.

Animals play a minor role in altering the landscape pattern and structural diversity of the forest. Deer and rabbit browsing may slow down plant succession in a few isolated areas by keeping the vegetation in an early seral stage for a longer period. This can give a competitive advantage to unpalatable species (e.g., whiteleaf manzanita). Livestock grazing can have the same effect. Deer can also thin dense patches of saplings by debarking (polishing their antlers).

Forest Stand Vigor and Growth

Many of the stands in the Applegate-Star/Boaz Watershed Analysis Area appear to be in a state of decline. Acceptable forest growth is attained when forests grow at a rate that satisfies the desired structural and production characteristics for the specific resource management objectives of the stand. An acceptable rate necessitates that forests are sufficiently resilient and vigorous to sustain these desirable characteristics through time. Management objectives for the analysis area may include reducing the risk of tree mortality from insects, disease, and wildfire, and restoring the vigor, resiliency, and stability of forest stands. The goal of the *Draft Applegate Adaptive Management Area Guide* (USDA and USDI 1996) is to achieve healthy, diverse, and functioning ecosystems that are sustainable over time. This could be achieved in the majority of cases by commercial thinning or selection harvest methods.

The predominant soils in the analysis area are Caris-Offenbecher gravelly loams and Vannoy-Voorhies Complex. The Douglas-fir 50-year site index for these soils ranges from 65 to 75 (that is, in 50 years, Douglas-fir trees will range from 65 to 75 feet in height). Micro sites with better soil/water conditions have taller trees. Numerous stands that originated with thousands of trees per acre are overstocked and unless they are treated, may not reach their true height or diameter potential.

Observations and data indicate that most forest stands of the Applegate-Star/Boaz Watershed

Analysis Area lack resiliency and vigor. A diminished ability to resist potentially damaging forest insects, particularly bark beetles, is characteristic of forests that lack vigor. The ongoing escalation of bark beetle related tree mortality throughout the analysis area is consistent with this premise. The primary factor contributing to diminished forest vigor is the elevated forest density resulting in excessive competition for resources including water, light, and nutrients. At the present time, the pole, mid, and mature/old-growth condition classes are not meeting their growth potential because of overstocking. Overall, acceptable growth rates are not being attained in the Applegate-Star/Boaz Watershed Analysis Area, nor are they presently on a trajectory for attainment in the foreseeable future (see the Management Objectives and Recommendations section for recommended tree growth rates).

PLANT SPECIES AND HABITATS

Special Status Plant Species and Habitats

The current habitat conditions and trends for the special status plant species known to occur in the Applegate-Star/Boaz Watershed Analysis Area are in decline.

Much of the habitat for *Cypripedium fasciculatum* in Alexander Gulch has been clearcut. The remaining known viable site is a half acre with 120 plants, which was reserved from timber harvesting. Fragmentation and physical disturbance of the habitat, edge effects, loss of habitat, and decrease in pollinator abundance have reduced the numbers of this species in the analysis area. Much of *C. montanum*'s habitat has been disturbed through clearcuts and shelterwood cutting or roads dissecting the populations. These two species must have a mycorrhizal association for germination and establishment of seedlings. This relationship exists throughout the life of the plant (longevity may be near 100 years). These *Cypripediums* appear to be very sensitive to any type of ground disturbance, possibly due to the disruption of the mycorrhizal association.

Habitat for *Fritillaria gemeri* and *Lonicera interrupta* may be in decline due to fire suppression.

Habitat for the *Lewisia corydon*, *Sedum laxum* ssp. *hecknerii*, and *Sedum oblancheolatum* has not been greatly altered, as they occur on rocky outcrops and rocky slopes. The greatest habitat impacts for these two genera are road construction, road improvement, and rock quarries. *Sedum oblancheolatum* lost some habitat due to a road that dissected a known population. *Sedum radiatum* ssp. *depauperatum* occurs on the forest floor and has received greater impacts to its habitat.

Many nonnative species have been introduced into the analysis area through erosion control seeding on burned areas or road cuts. Noxious weeds have begun to invade the area. Both nonnative species and noxious species utilize habitat and soil moisture that native species need for new plants to become established.

Entire plant communities have been lost in areas where land has been cleared for agricultural and domestic use.

Survey and Manage Plant Species and Habitats

Survey and Manage vascular plant species that occur in the analysis area (*Cypripedium fasciculatum* and *C. montanum*) are at risk of extirpation through loss of habitat and disrupted ecosystem functioning (see Special Status Plants). These species occur in very small localized populations and are dependent on other organisms in the analysis area for pollination, dispersal, nutrients, and habitat.

Surveys conducted to describe the non-vascular component of the Star Gulch flora indicated Star Gulch, which is exceptionally rich in non-vascular plants including fungi, lichens, and bryophytes, may be the most mycologically diverse drainage in the Ashland Resource Area. Three of these fungi, *Cantharellus subalbidus* (white chanterelle), *Phlogiotis helvelloides*, and *Phyocoris ericetorum* are on the Survey and Manage list. In addition, the occurrence of five Survey and Manage lichens found in the drainage has been documented.

Noxious Weeds

Noxious weeds are unintentionally introduced by several modes. Some of the more common modes are: road and power line construction (creating corridors into an area), humans, animals, or vehicles (acting as carriers from one area to another); or contaminated livestock feed. Once established, many of these species possess the ability to out-compete the native vegetation even in the absence of a disturbance.

Current Medford District policy pertaining to noxious weeds includes assisting Oregon Department of Agriculture's efforts to identify, control, and track the distribution and spread of target species on BLM-managed lands.

FIRE

Fire risk is defined as the probability of various ignition sources causing a fire, that threatens valuable resources, property, and life. The fire risk of the Applegate-Star/Boaz Watershed Analysis Area is rated as high (USDA and USDI 1994b). The highest risk areas are major ridges due to lightning strikes and lands adjacent to open roads and private property due to the potential for human-caused fires. Historical lightning occurrence indicates there is the potential of lightning fires starting throughout all elevations within the analysis area. Some of the high values at risk within the watershed are private residential and agricultural property, water quality, and forest resources such as northern spotted owl core areas, soil productivity, mature/old-growth timber stands, and plantations.

Current vegetation conditions are favorable to larger fires of higher intensities than in the past. Present day wildfires tend to destroy the majority of existing vegetation. This "stand

replacement" process can create distinct changes in plant communities. The Star Gulch fire of 1987 is a good example of this process. In 1987, wildfires burned a total of 3,885 acres of BLM-managed land within the Applegate River Subbasin. Approximately 77 percent of these acres burned at a moderate to high intensity. The Star Gulch Fire burned a total of 1,735 acres, of which 67 percent burned at a moderate to high intensity.

Current land management direction calls for the use of prescribed fire as a tool to meet resource management objectives. Prescribed fire is typically used to reduce existing fire hazard, regulate vegetation species mix, structure, and/or density, enhance habitat for plant and animal species, and/or reduce noxious weeds.

Fire hazard ratings, which determine the threat of ignition, spread, and fire control difficulty, were developed to assess vegetation for density, type, vertical structure, arrangement, volume, condition, and location (aspect and slope). In general, the existing fuel profile within the Applegate-Star/Boaz Watershed Analysis Area represents a moderate to high resistance to control under average climatic conditions. Most of the forest stands within the analysis area have a dense overstory, a moderate amount of ground fuel, and ladder fuels. Optimal conditions exist for the occurrence of crown fires, which could result in large stand replacement fires. Crown fires also present an extreme safety hazard for suppression crews. Fire hazard ratings for the analysis area are displayed on Map 17 and Table 9.

Clearcutting over the past two decades in Alexander, Benson, and Lightning gulches has created changes in vegetation patterns, which would not have occurred naturally over such a large area. The existing stands are in the early seral stages, which are more susceptible to fire due to the fuel types present.

Table 9. Fire Hazard Ratings

Hazard	Acres
Low	591
Medium	12,581
High	4,490

Measurements of smoke or pollutants have only occurred over the past three to four decades. The Clean Air Act directed the State of Oregon to meet the national ambient air quality standards by 1994. The Oregon Smoke Management Plan identified strategies to minimize the impacts of smoke from prescribed burning on smoke sensitive areas within western Oregon. Particulate matter the size of 10 microns (PM10) or less is the specific pollutant addressed in this strategy. Currently, the population centers of Grants Pass and Medford/Ashland are in violation of the national ambient air quality standards for PM10 and are classified as nonattainment areas for this pollutant. The nonattainment status of these areas is not attributable to prescribed burning. Major sources of particulate matter within the Medford/Ashland area are smoke from woodstoves (63 percent) and dust and industrial sources (18 percent). Prescribed burning contributes less than four percent of the annual total.

By the year 2000, the goal of the Oregon Smoke Management Plan for all of western Oregon is to reduce particulate matter emissions from prescribed burning by 50 percent. Particulate matter has been reduced by 42 percent since the baseline period (1991).

Emissions from wildfires are significantly higher than from prescribed burning. The 1987 southern Oregon wildfires emitted as much particulate matter as all the burning that occurred within the State that year. Prescribed burning under spring-like conditions consumes less of the larger fuels than wildfire, thus creating fewer emissions. During the prescribed burning season, smoke dispersal is easier to achieve due to the general weather conditions that occur. The use of aerial ignition reduces the total emissions by accelerating the ignition period and reducing the smoldering stage of the combustion process.

The effect of smoke produced from prescribed burning may temporarily reduce visibility within the analysis area or may concentrate the smoke around the project site or surrounding drainages. Prescribed burning would comply with the guidelines established by the Oregon Smoke Management Plan and the Visibility Protection Plan.

TERRESTRIAL WILDLIFE SPECIES AND HABITATS

Wildlife-General

The various vegetation condition classes in the analysis area provide habitat for 200+ terrestrial wildlife species that are known or suspected to occur in the analysis area. Table 10 lists wildlife species that are representative of these plant communities and condition classes.

Table 10. Vegetation Condition Classes and Representative Wildlife Species

Condition Class	Representative Species
Grass, forbs, herbaceous vegetation	Gopher snake, western meadowlark, and California ground squirrel.
Shrubs, non-forest land	Western fence lizard, wren-tit, and dusky-footed woodrat.
Hardwood/woodland	Ringsneck snake, acorn woodpecker, and western gray squirrel.
Early and seedling/sapling	Northwestern garter snake, mountain quail, and pocket gopher.
Pole (5-11" dbh)	Southern alligator lizard, golden-crowned kinglet, and porcupine.
Mid (11-21" dbh)	Emertina, Steller's jay, and mountain lion.
Mature/old-growth (21" + dbh)	Siskiyou mountains salamander, northern spotted owl, and northern flying squirrel.

Even though wildlife species diversity is high, elements of decline are present in all habitat types/condition classes. Grass/forbs/herbaceous habitat is less productive due to the encroachment of noxious species, and declining in abundance due to the encroachment of other plant communities (for example, mountain shrubland and mixed conifer). Most regeneration of mountain shrubland vegetation is dependent on fire, and in its absence, the trend has been

toward decadence with little regeneration. The result is a lack of early seral conditions in this plant community. Abundance and condition of oak-woodland habitat has decreased due to the encroachment of conifers and overstocking of shrubs.

In the mixed conifer plant community, snag density and down woody material is inadequate in many early seral and pole stands due to removal during timber harvest. Due to fire suppression, some pole and mature conifer stands are more dense than they would be under natural fire regimes, and the lack of intrastand structure in these stands generally results in lower wildlife species diversity in comparison to other condition classes. The abundance of mature/old-growth habitat has declined primarily due to timber harvest.

Although supportive data are not available, the general decline in habitat condition probably has not resulted in a decrease in wildlife species richness. Rather, there have been changes in populations and distribution as habitat abundance and condition changed.

Mine shafts and rock outcrops with associated talus provide special/unique wildlife habitats in the analysis area. Rock outcrops and talus, which are scattered throughout the analysis area, normally occur in small pockets but can be quite widespread. In combination with the proper microclimatic conditions, talus provides important habitat for at least one special status species within the analysis area, the Siskiyou Mountains salamander.

Mine shafts are present in several locations within the analysis area. A variety of wildlife species use mines to fulfill some of their life functions with the bats being the most notable. Depending on the species, mines are used as rest sites, day roosts, night roosts, hibernation, or maternity sites. Mines in the analysis area have not been inventoried.

Late-Successional Habitat

Late-successional (mature/old-growth) habitat is important to a number of wildlife species within the watershed analysis area, including the northern spotted owl. The decline of this habitat within the range of the northern spotted owl resulted in the federal listing of the spotted owl as threatened and the subsequent development of the Northwest Forest Plan. There are 2,200 acres of late-successional habitat in the analysis area. These 2,200 acres constitute 18 percent of the forest lands in the watershed.

Threatened/Endangered Species

Northern spotted owls, a federally listed threatened species, are present in the analysis area. Four spotted owl activity centers have been found and three are currently active. Reproduction has been documented at two of these three sites.

Within the analysis area, there are 5,426 acres of suitable habitat and 2,058 acres of dispersal habitat. Suitable habitat provides nesting, roosting or foraging areas for spotted owls and generally has the following attributes: high degree of canopy closure (approximately 60 percent or greater), multilayered canopy, and presence of large snags and coarse woody material. Dispersal habitat provides a degree of protection from predators during dispersal,

but does not provide for nesting, roosting or consistent foraging. Canopy closure is generally 40 to 60 percent. The distribution of suitable and dispersal habitat in the analysis area is shown on Map 18.

The amount of suitable habitat within the median home range of an activity center is often indicative of the probability of successful nesting and continued occupancy of a site. Suitable habitat is further classified as nesting or roosting/foraging habitat which indicates the quality of habitat; that is, nesting habitat is considered high quality while roosting/foraging may be of somewhat lesser quality. Table 11 shows the amount of suitable habitat within the median home range for the three active sites.

Table 11. Suitable Habitat Within the Median Home Range

Site Number	Nesting Habitat (Acres)	Roosting/ Foraging Habitat (Acres)	Total Suitable Habitat (Acres)
0873	611	1,259	1,870
2233	450	769	1,219
0872	336	821	1,157

As an indication of how these acres provide for spotted owl nesting, roosting and foraging, a threshold of 1,360 acres of suitable habitat within the median home range has been used by the U.S. Fish and Wildlife Service (USFW) for determining incidental take; that is, if suitable habitat is being removed by an activity and existing suitable habitat is below or will be reduced to less than the threshold acres, there is incidental take of the species.

Bald eagles, a threatened species, are not known to be routinely present in the analysis area. They may, however, opportunistically forage along the Applegate River.

Northern Spotted Owl Critical Habitat

Approximately 11,300 acres of the analysis area are in designated critical habitat, of which 10,500 acres are in CHU OR-74 and 800 acres are in CHU OR-75. The U.S. Fish and Wildlife Service designates critical habitat to preserve options for recovery of the species by identifying existing habitat and highlighting areas where management should be given high priority (USDI (FWS) 1995). In the case of the northern spotted owl, critical habitat was designated to protect clusters of reproductively-capable owls and facilitate demographic and genetic interchange (USDI (FWS) 1995). Critical habitat was designated prior to implementation of the Northwest Forest Plan (NFP). The biological opinion for the NFP acknowledges the Late-Successional Reserve (LSR) system established in the NFP as a reasonable approximation to critical habitat. Hence, the current function of critical habitat outside of LSRs is for dispersal, which provides demographic and genetic interchange between LSRs.

Map 19 shows critical habitat boundaries within the analysis area and the distribution of suitable and dispersal habitat within the CHU. There are 4,357 acres of suitable habitat and

1,502 acres of dispersal habitat within critical habitat in the analysis area.

Survey and Manage Species and Protection Buffer Species

Eight species known or suspected to be present in the analysis area are afforded extra protection in the NFP under Standards and Guidelines for Survey and Manage and Protection Buffer species. These species are the Siskiyou Mountains salamander (Survey and Manage and Protection Buffer species), red tree vole (Survey and Manage species), great gray owl (Protection Buffer species), and five species of molluscs (Survey and Manage).

There are several known sites for Siskiyou Mountains salamanders in the analysis area. The salamanders are talus obligates and are thought to prefer stabilized talus with a mature/old-growth conifer overstory. Older forests provide a high degree of canopy closure, which maintains the moist and humid microclimate the species requires. As previously mentioned, talus is found in small pockets and larger inclusions throughout the analysis area. The species is likely present in those talus areas that are in the mature/old-growth habitat condition class.

Little is known about red tree voles in the analysis area. Their presence has been verified through spotted owl pellet analysis and the presence of nest material. They are thought to be associated with mature and old-growth conifer forests with a high degree of canopy closure. Suitable habitat for northern spotted owls (Map 18) would also generally be considered suitable for red tree voles.

Surveys indicate great gray owls are known to be present in the analysis area. These owls are associated with forested areas that are adjacent to grasslands and early seral conditions of conifer plant associations. They nest in conifer stands and forage in grasslands and other open areas. Map 20 shows there are numerous areas with an interface of grassland/early seral and mid-/mature/old-growth. Approximately 2,100 acres of the analysis area are potential habitat for great gray owls based on the survey protocol for the species.

The five mollusc species have habitat requirements ranging from talus to conifer forest. Little is known about these species and no surveys have been conducted in the analysis area.

Special Status Species

Special status species include those species that are listed by the U.S. Fish and Wildlife Service as threatened or endangered, proposed or candidate for listing as threatened or endangered, or are listed by the BLM as sensitive or assessment species.

Twenty-one special status species are known or suspected to be present in the Applegate-Star/Boaz Watershed Analysis Area. Table 12 lists these species, their status, and the primary reason they are listed as special status species.

Table 12. Special Status Wildlife Species

Species	Status ¹	Primary Reason(s) for Status
Western Pond Turtle (<i>Chemyda marmorata</i>)	BS	Habitat loss/degradation and predation.
Siskiyou Mountain Salamander (<i>Plethodon storeri</i>)	BS	Limited range and habitat loss.
Foothill Yellow-legged Frog (<i>Rana boylei</i>)	BS	Population decline (unknown reasons).
California Mountain Kingbird (<i>Lampropedia caerulea</i>)	BA	General rarity.
Common Kingbird (<i>Lampropedia gairdneri</i>)	BA	General rarity.
Northern Spotted Owl (<i>Strix occidentalis caurina</i>)	T	Habitat loss.
Bald Eagle (<i>Haliaeetus leucocephalus</i>)	T	Shooting, pesticides and disturbance.
Northern Goshawk (<i>Accipiter gentilis</i>)	BS	Habitat loss.
Great Gray Owl (<i>Strix nebulosa</i>)	BS	Habitat loss.
Flammulated Owl (<i>Otus flammulus</i>)	BA	Habitat loss.
Northern Saw-whet Owl (<i>Argophilus acadicus</i>)	BA	Habitat loss.
Pileated Woodpecker (<i>Dryocopus pileatus</i>)	BA	Habitat loss.
Lewis' Woodpecker (<i>Aryndonax lewis</i>)	BA	Fire suppression and salvage logging following fires.
Western Meadowlark (<i>Icterus spurius</i>)	BA	Development (residential and commercial).
Western Bluebird (<i>Sialis mexicana</i>)	BA	Development.
Townsend's Big-eared Bat (<i>Plecotus townsendii</i>)	BS	General rarity and lack of information.
Fringed Myotis (<i>Myotis myotis</i>)	BS	General rarity and lack of information.
Long-eared Myotis (<i>Myotisotis</i>)	BS	General rarity, lack of information and habitat loss.
Yuma Myotis (<i>Myotis yumanus</i>)	BS	General rarity and lack of information.

Species	Status ¹	Primary Reason(s) for Status
Long-legged Myotis (<i>Myotis velox</i>)	B3	General rarity, lack of information and habitat loss.
Pacific Puffin (<i>Asturion puffinus</i>)	B3	General rarity and lack of information.

1/ Status:

T: Listed as threatened under the ESA

B3: Bureau sensitive

BA: Bureau assessment

FB: Designated to receive protection buffers in the ROD

SM: Designated as a Survey and Manage species in the ROD

HYDROLOGY

For purposes of the hydrology discussion, the Applegate-Star/Boaz Watershed Analysis Area is stratified into two areas, Star Gulch and the Applegate River frontals. Star Gulch is subdivided into 19 drainage areas and the Applegate River frontals consists of three drainage areas that include the Applegate River and Boaz Gulch (Map 10).

Groundwater

Baseline information to assess the current status of groundwater quantity or quality is not available. Recent years of below normal precipitation have resulted in reduced recharge of groundwater supplies. Water rights for groundwater in the Applegate-Star/Boaz Watershed Analysis Area are minimal (0.04 cubic feet per second) and solely for irrigation use.

Groundwater uses exempt from water rights include: stock watering, lawn or non-commercial garden watering of no more than .5 acres, and single or group domestic purposes for no more than 15,000 gallons per day. Information is not available regarding the amount of exempt uses.

Streamflow

Peak Flow

Maximum peak flows generally come in December and January as a result of rain-on-snow storm events (LaLande 1995). These peak flow events occur when a substantial amount of rain falls on accumulated snow in the transient snow zone. The combination of rain moving into the stream channels and the rapid snowmelt can result in flooding. The transient snow zone occupies 21 percent of the analysis area, 33 percent of the Star Gulch drainage, and 51 to 77 percent of the upper drainage areas in Star Gulch (Map 6).

Upland disturbances, both natural and human-caused, can result in increased magnitude and frequency of peak flows. Increases in size and frequency of peak flows may result in accelerated streambank erosion, scouring and deposition of stream beds, and increased

sediment transport. The natural disturbance that would have the greatest potential to increase the size and frequency of peak flows is a severe, extensive wildfire. In the Applegate-Star/Boaz Watershed Analysis Area, the primary human-caused disturbances that can potentially affect the timing and magnitude of peak flows include the Applegate Dam, roads, soil compaction (due to logging, agriculture, concentrated livestock grazing, and residential development), and vegetation removal (due to timber harvest and conversion of timbered sites to agriculture or residential use). Quantification of these affects on streamflow in the Applegate-Star/Boaz Watershed Analysis Area is unknown.

The Applegate Dam, completed in 1980, has moderated high flows in the portion of the Applegate River flowing through the analysis area, resulting in fewer and smaller peak flows (Appendix A, Table A1). Prior to the dam, the highest instantaneous flow recorded was 29,800 cubic feet per second (cfs) near Copper in 1974. Since the dam was built, the highest instantaneous flow near Copper was 18,800 cfs in 1997 (as of water year 1997).

Roads alter the hydrologic network and may increase the magnitude of peak flows and affect the time it takes for runoff to reach a stream. Roadcuts intercept subsurface water and road ditches convey it to streams. Road surfaces collect water during storm events and this water is transported to streams (Wemple 1994). This effect is more pronounced in areas with high road densities and where roads are in close proximity to streams. Map 16 gives a visual portrayal of road densities for all ownerships. Road information for drainage areas in the Applegate-Star/Boaz Watershed Analysis Area is shown in Table A2 (Appendix A). High road densities are found in Upper Star Gulch (5.3 mi/mi²), Alexander Gulch (8.8 mi/mi²), and Benson Gulch (5.1 mi/mi²) drainage areas. The number of road stream crossings by drainage area shown in Table A2 (Appendix A) partly reflects road proximity to streams. Upper Star Gulch, Alexander Gulch, and Lightning Gulch have the greatest number of stream crossings in Star Gulch. All three Applegate frontal drainage areas have a large number of stream crossings.

Soil compaction resulting from yarding corridors, agriculture, and concentrated livestock grazing also affects the hydrologic efficiency within a watershed by reducing the infiltration rate and causing more rainfall to quickly become surface runoff instead of slowly moving through the soil to stream channels (Brown 1983). Soil compaction data from yarding activities was compiled during a cumulative effects analysis for Star Gulch in 1991. Total compacted area in Star Gulch was 1.9 percent, with Alexander Gulch (4.4 percent) and Benson Gulch (3.7 percent) being the drainage areas with the highest compaction. Soil compaction calculated for Boaz Gulch in 1992 was 2.5 percent. Soil compaction data has not been compiled for the other two Applegate frontal drainage areas.

Vegetation removal reduces interception and transpiration and allows more precipitation to reach the soil surface and drain into streams or become groundwater. Until the new vegetation obtains the same crown closure as the previous unmanaged stand, it is considered to be hydrologically unrecovered. Vegetation condition class by drainage area is shown in Table A3 (Appendix A). Large amounts of vegetation removal in the transient snow zone are of particular concern due to alterations of the streamflow regime and resultant increased peak flow magnitudes (Christner and Harr 1982). This effect could be substantial in the upper Star

Gulch drainage areas from Alexander Gulch to the headwaters due to the high percentage (62 percent) of land in the transient snow zone and the amount of timber harvest that has occurred (29 percent). Within upper Star Gulch, Alexander Gulch has the greatest area that is hydrologically unrecovered (32 percent). The vegetation is hydrologically unrecovered in 24 percent of Benson Gulch. The two frontal drainage areas that are immediately upstream and downstream of Benson Gulch also have a high percentage (24 and 30 percent, respectively) of hydrologically unrecovered vegetation due to the 1987 wildfire.

Low Flow

Summer streamflows in the Applegate-Star/Boaz Watershed Analysis Area reflect the low summer rainfall (Figures 3 and 4, Characterization). Naturally low summer flows are exacerbated by periods of below normal precipitation. Many perennial, tributary streams in the analysis area have been drying up during summers in years with below normal precipitation. The greatest need for water occurs during the summer when demand for irrigation and recreation use is highest.

Table 13 summarizes water right information obtained from the Oregon Water Resources Department (OWRD 1995). The majority of water right diversions in the Applegate-Star/Boaz Watershed Analysis Area are from the Applegate River and are used for irrigation. They are either primary rights from the river or supplemental rights taken from Applegate Reservoir releases. The remaining water diversions are located in the lower reaches of the tributaries, with Boaz Gulch having the highest allocation rate.

Table 13. Water Rights

Water Body	Oldest Priority Date	Uses and Percent of Total Allocation	Allocation Rates (cfs)		
			Surface Water	Ground-water	Total
Applegate Reservoir	8/3/1981	irrigation (100)	0.15	0	0.15
Applegate River	12/31/1876	irrigation (84), fish (16)	12.80	0	12.80
Applegate River Frontals (Unnamed)	4/10/1912	domestic (29), irrigation (65), fire protection (1.5), fish (3), wildlife (1.5)	0.62	0.06	0.68
Boaz Gulch	2/15/1934	domestic (.3), irrigation (68.1), mining (31.6)	3.17	0	3.17
Lime Gulch	12/6/1926	domestic (9), irrigation (91)	0.11	0	0.11
Mill Gulch	12/6/1926	domestic (8), irrigation (92)	0.13	0	0.13

Water Body	Oldest Priority Date	Uses and Percent of Total Allocation	Allocation Rates (cfs)		
			Surface Water	Groundwater	Total
Star Gulch	7/19/1946	domestic (.3), irrigation (.3), mining (99.4)	3.0	0.01	3.01

Source: Oregon Water Resources Department (1995)

Regulated flows in the Applegate River below Applegate Dam have moderated low flows, resulting in fewer extreme low flow conditions (Appendix A, Table A1). The lowest instantaneous flow recorded near Copper was 12.0 cfs in 1979 prior to the dam and 27.0 cfs in 1986 after the dam was completed.

The Rogue River Basin Program (OWRD 1989) established minimum perennial streamflows for the Applegate River near Copper (Table 14).

Table 14. Minimum Perennial Streamflows

Minimum Perennial Streamflows (cfs)												
Stream Name	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Applegate River at USGS gage near Copper	130	100	100	100	100	170	170	170	200	230	200	200/130

Source: OWRD 1989

Dense (overstocked) forest stands are another factor that may be contributing to low summer flows. Densely vegetated areas have high interception and transpiration rates, thereby decreasing the amount of moisture reaching surface and groundwater bodies. Distribution of vegetation condition classes provides some insight as to vegetative cover and hydrologic response. Acres of vegetation by condition class are shown in Table A3 (Appendix A). Dense forest stands are scattered throughout the analysis area.

STREAM CHANNEL

The Oregon Department of Fish and Wildlife conducted a stream survey in Star Gulch during 1993. The survey indicated that 7.7 percent of the streambanks were actively eroding in the main channel from the mouth to the headwaters. An intensive stream inventory is needed to identify channel stability and condition in the remainder of the analysis area.

There is a noticeable lack of large woody debris (LWD) in the stream channels. Within Star Gulch below Deadman Gulch the average LWD volume is 8.4 m³ per 100 meters and above Deadman Gulch it is 30.3 m³ per 100 meters (ODFW 1993). LWD in the streams contributes to the form and structure of a stream's channel and largely controls the distribution of aquatic habitats (see Aquatic Wildlife), streambank and streambed stability, and sediment and water

routing through the system. LWD traps and slows the movement of sediment and organic matter through the stream system. Large wood is particularly critical for the steep tributaries because it creates a stepped stream profile, with stream energy dissipated in relatively short, steep sections of the channel.

Substrate composition is a good indicator of sediment problems in the stream system and is also important for aquatic habitat (see Aquatic Wildlife). Substrate in Star Gulch varies by reach, but overall there is 16 percent bedrock, 16 percent boulders, 28 percent cobbles, 26 percent gravels, 7 percent sand, and 6 percent silt and fine organic matter (ODFW 1993). Stream substrate composition is unknown for the remainder of the analysis area.

The primary sediment source in the Applegate-Star/Boaz Watershed Analysis Area appears to be from road surfaces, fill slopes, and ditchlines. Soil that moves into the ditchlines is carried to stream systems by ditch runoff. Drainage areas with high numbers of road stream crossings are likely to experience the most sediment movement into stream channels. Upper Star Gulch, Alexander Gulch, Lightning Gulch, and the Applegate River tributaries have especially high numbers of stream crossings. These high energy Rosgen type A and Aa+ streams (see Stream Channel, Watershed Characterization) are capable of transporting sediment to downstream reaches that support fish.

Roads are adjacent to many of the stream reaches within the Applegate-Star/Boaz Watershed Analysis Area. In addition to being a sediment source, these roads confine the stream channel and restrict the natural tendency of streams to move laterally. This can lead to downcutting of the stream bed or erosion of the streambank opposite the road.

The trend for channel stability and condition should improve with additional large wood recruitment over the long term. Roads will continue to supply sediment, although proper and frequent maintenance and decommissioning would reduce the sediment source.

WATER QUALITY

Section 303(d) of the Clean Water Act requires each state to identify streams, rivers, and lakes that do not meet water quality standards even after the implementation of technology-based controls. These waters are referred to as "water quality limited" and States are required to submit 303(d) lists to the Environmental Protection Agency every two years. The Oregon Department of Environmental Quality's (DEQ) 1994/1996 list of water quality limited water bodies includes the Applegate River from the mouth to the Applegate Reservoir. The Applegate River is water quality limited because two water quality parameters, flow modification and summer temperature, do not meet state water quality standards. The flow modification parameter indicates that documented flow conditions in the Applegate River below the reservoir are a significant limitation to fish or other aquatic life. Summer temperature was included because the seven day moving average of the daily maximum stream temperature exceeded 64°F, which is the state temperature criterion. Star Gulch from the mouth to 1918 Gulch is included on DEQ's 1998 draft list of water quality limited streams due to summer temperatures.

The Oregon Department of Environmental Quality's (DEQ) 1988 Oregon Statewide Assessment of Nonpoint Sources of Water Pollution identifies cold water fish as an impacted beneficial use in Star Gulch below Lightning Gulch. Star Gulch water quality problems have been identified as moderate by DEQ in their 1988 nonpoint source assessment and include low flows and insufficient stream structure. Information used by DEQ to make this assessment was based solely on observations. High stream temperatures are not listed in the DEQ report due to lack of data at the time the report was prepared (Ades 1995).

Probable causes (disturbances and alterations) associated with the water quality problems identified for Star Gulch in DEQ's 1988 assessment include vegetation removal and water withdrawals. Associated land uses include irrigated cropland/pastureland and harvesting. The water withdrawals for irrigated cropland/pastureland is questionable since the only valid water right for irrigation is for 0.01 cfs from a sump at the mouth of Star Gulch. The lower portion of Star Gulch is on private land and is subject to extensive cattle use.

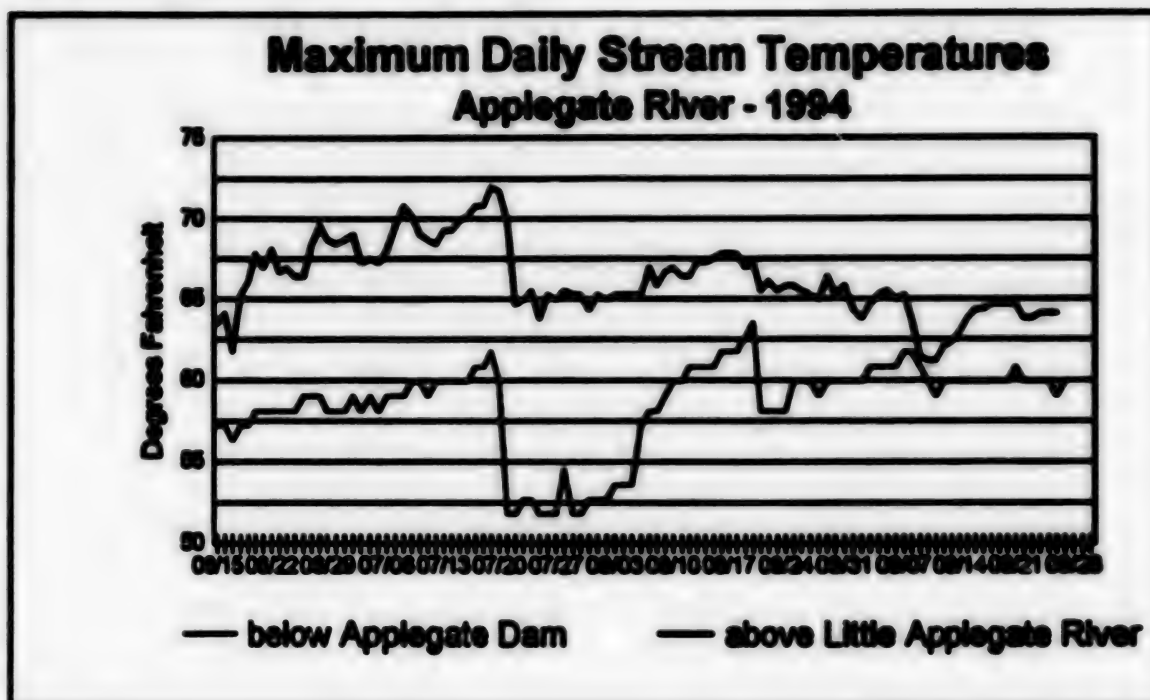
Water quality parameters most critical to the beneficial uses (Water Quality, Watershed Characterization) in the Applegate-Star/Boaz Watershed Analysis Area are: temperature, pH, dissolved oxygen, and sedimentation and turbidity. The processes and disturbances affecting these water quality parameters and current conditions are described below.

Temperature

Many factors contribute to elevated stream temperatures in the analysis area. Low summer streamflows, hot summer air temperatures, low gradient valley bottoms, lack of riparian vegetation, and high channel width-to-depth ratios result in stream temperatures that can stress aquatic life. Natural disturbances that can affect stream temperature are climate (high air temperatures), below normal precipitation (low flows), and wildfires and floods (loss of riparian vegetation). Human disturbances affecting stream temperatures include: water withdrawals; channel alterations; and removal of riparian vegetation through logging, concentrated livestock grazing, or residential clearing.

Water temperatures in the Applegate River below the dam are influenced by water releases from the dam. Temperatures immediately below the dam are less than the State temperature criteria. The 1994 seven-day average maximum temperature of the Applegate River rose from 61.8°F below the dam to 70.9°F above the confluence with the Little Applegate River, approximately 10 miles downstream. Figure 5 shows the difference in 1994 maximum daily stream temperatures between the Applegate River below the dam and the Applegate River above Little Applegate River. The 1994 stream temperature data is used because the 1995 data was incomplete due to equipment malfunction at the USGS gaging station below the dam. Summer water temperatures in the mainstream of the Applegate River are noticeably lower since construction of the Applegate Dam (USDI 1995).

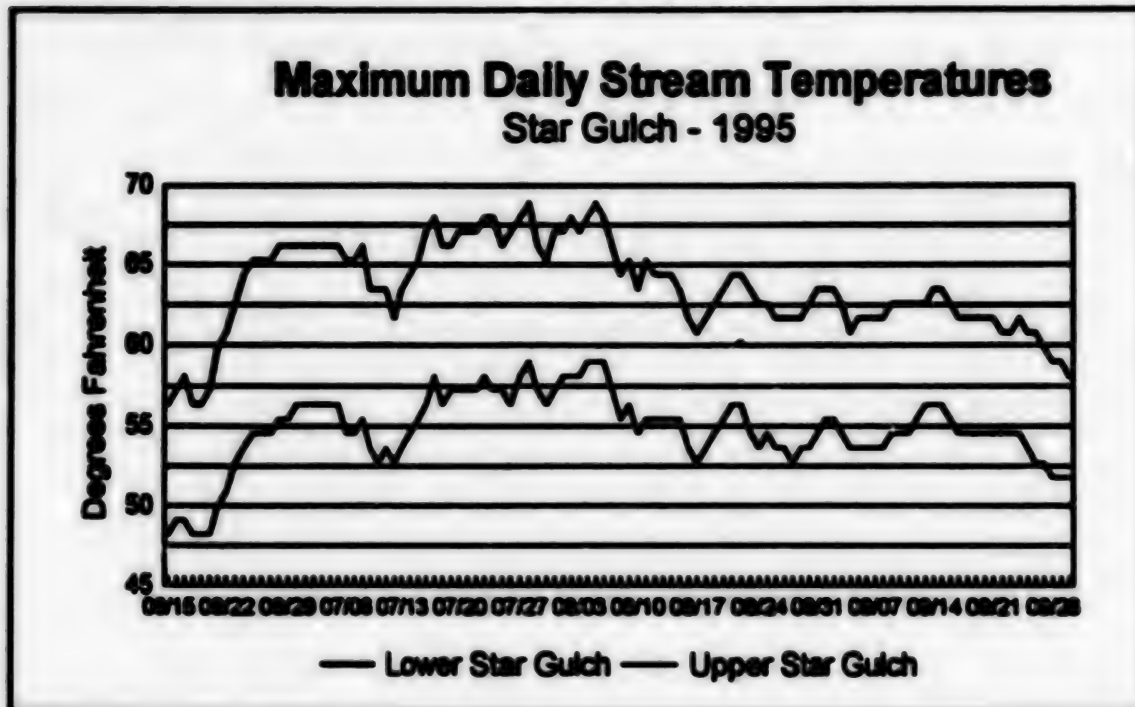
Figure 5. Maximum Daily Stream Temperatures in 1994 for the Applegate River above Little Applegate River and Below the Applegate Dam



Source: USGS and BLM data

The 1995 and 1996 seven-day moving averages of the daily maximum stream temperature at the Star Gulch USGS gaging station exceeded the State water temperature criteria, but the data was not available when the 1994/1996 list of water quality limited streams was compiled. Star Gulch from the mouth to 1918 Gulch is included on the draft 1998 303(d) list. Summer water temperatures recorded at the upper Star Gulch site, above Deadman Gulch, did not exceed the State temperature criterion. Figure 6 shows the difference in maximum daily stream temperatures between upper and lower Star Gulch.

Figure 6. Maximum Daily Stream Temperatures in 1995 for Star Gulch at the Gaging Station (Lower Star Gulch) and Above Deadman Gulch (Upper Star Gulch)



Source: BLM data

Summer water temperatures were obtained for Star Gulch tributaries in 1996. Stream temperatures recorded for Deadman, Alexander, Ladybug, Lightning and Benson gulches remained below the State temperature criterion.

Water temperature data summaries for the Applegate River and Star Gulch during the summers of 1994, 1995, and 1996 are shown in Appendix B.

pH

pH is defined as the logarithmic concentration of hydrogen ions in water in moles per liter. pH can have direct and indirect effects on stream water chemistry and the biota of aquatic ecosystems. pH varies inversely with water temperature and shows a weak inverse relationship to discharge. Forest management activities can indirectly affect pH through the introduction of large amounts of organic debris and by increasing light to streams (MacDonald et al. 1991).

State water quality criteria for pH in the Rogue Basin ranges from 6.5 to 8.5. Fifteen pH measurements taken at the Star Gulch gaging station between October 1983 and September 1985 ranged in value from 7.7 to 8.7 with an average of 8.3 (USDI 1985). The Upper Star Gulch site was monitored for pH in 1985 and had a range of 8.3 to 8.4 with an average of 8.3. pH measurements made in tributaries to Star Gulch during 1985 ranged from 7.8 to 8.6, with

the lowest values found in Deadman and Lightning gulches and the highest values found in Ladybug and Benson gulches. Star Gulch and its major tributaries were sampled for pH in September 1996 with the following results: Star Gulch at the gaging station, 8.2; upper Star Gulch, 8.2; Deadman Gulch, 7.7; Alexander Gulch, 8.2; Ladybug Gulch, 7.9; Lightning Gulch, 7.8; and Benson Gulch, 8.0. pH for Star Gulch and its tributaries appears to be within the expected range.

Dissolved Oxygen

Dissolved oxygen (DO) concentration refers to the amount of oxygen dissolved in water. DO is critical to the biological community in the stream and to the breakdown of organic material (MacDonald et al. 1991). Dissolved oxygen concentrations are primarily related to water temperature (MacDonald et al. 1991). When water temperatures increase, oxygen concentrations decrease.

The State dissolved oxygen standard was revised in January 1996. The new standard describes the minimum amount of DO required for different water bodies (waters that support salmonid spawning until fry emergence from the gravels, waters providing cold-water aquatic resources, and waters providing cool-water aquatic resources). Dissolved oxygen was measured in Star Gulch and its major tributaries between May and October during 1983, 1984, and 1985 (USDI 1985). The measurements ranged from 8.8 milligrams per liter (mg/l) to 11.7 mg/l and 83 to 107 percent saturation. Average percent saturations of dissolved oxygen were 87 percent in Lightning Gulch, 88 percent in Deadman Gulch, 92 percent in upper Star Gulch, 93 percent in Ladybug Gulch, 94 percent in Alexander Gulch, and 95 percent in Benson Gulch and lower Star Gulch. Further monitoring is needed to meet the data requirements of the revised standard and to determine if dissolved oxygen levels are within the established criteria.

Sediment and Turbidity

Sedimentation is the natural process of fine sediments (sand and silt) entering a stream channel. However, an excess of fine sediments can cause problems such as turbidity (the presence of suspended solids) or embeddedness (buried gravels and cobbles). Sedimentation is generally associated with storm runoff and is highest during fall and winter. Most of the sediment generated in headwater streams is transported out of the steep tributary channels and into the lower gradient main channels where it is deposited. Natural processes that occur in the analysis area such as surface erosion, wildfire, and flood events contribute to increased sedimentation.

Accelerated rates of upland erosion in the analysis area are primarily caused by logging and road building. Older roads with poor locations, inadequate drainage control and maintenance, and unsurfaced roads are more likely to erode and cause the sedimentation of stream habitats. Road-related erosion in the analysis area has been noted in the headwaters of Boaz Gulch and Upper Star Gulch.

In the Applegate River corridor, increased sedimentation can be attributed to grazing in riparian zones and residential clearing (USDA and USDI 1995). Streambank erosion is

accelerated by riparian vegetation removal. Annual maintenance of many diversion structures, especially gravel dams, and irrigation return flows also cause sedimentation (Applegate River Watershed Council 1994).

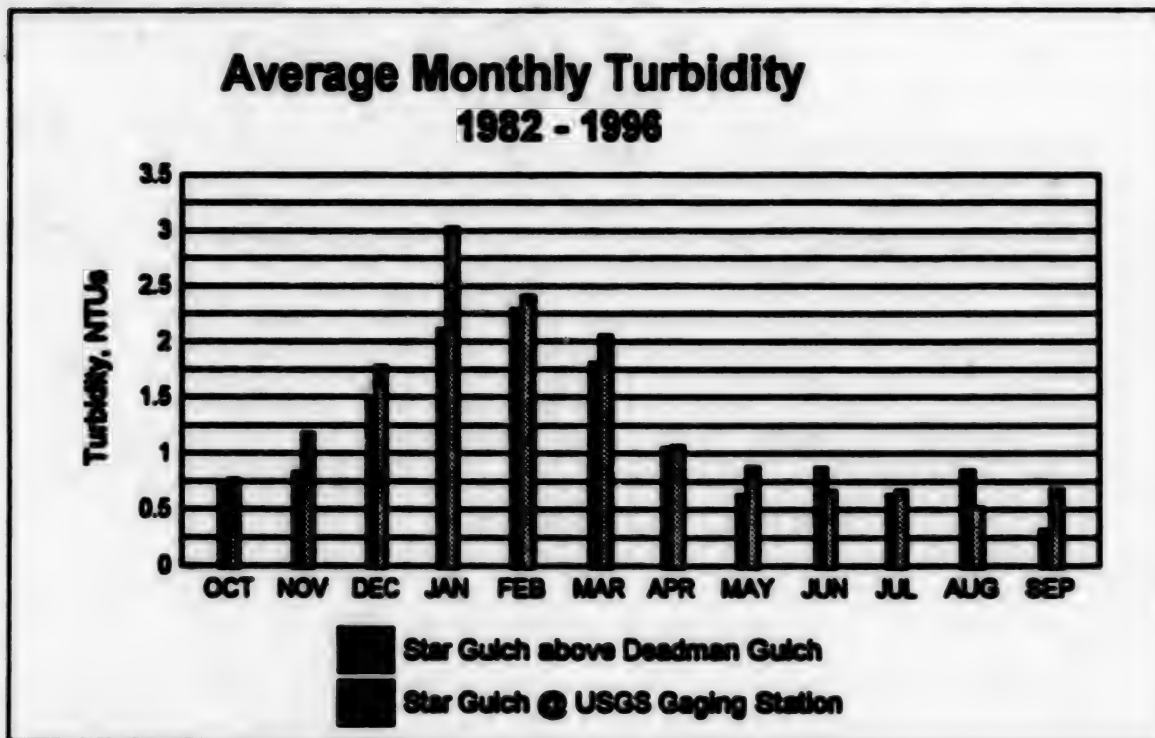
Turbidity data has been collected for Star Gulch and its tributaries since 1982. Automatic water samplers are located at the USGS streamflow gaging station near the mouth of Star Gulch and above Deadman Gulch. A comparison between average monthly turbidity for these two sites is shown in Figure 7. The average annual turbidity for Star Gulch at the USGS gaging station is 1.62 Nephelometer Turbidity Units (NTUs), with a maximum value of 55.3 NTUs and a minimum of 0.08 NTUs. The average annual turbidity for Star Gulch above Deadman Gulch is 1.41 NTUs, with a maximum value of 20.01 NTUs and a minimum of 0.11 NTUs. Turbidity has also been measured from grab samples collected at the above two sites and the major Star Gulch tributaries. Average and maximum turbidities from grab samples collected between 1982 and 1996 are shown in Table 15. Turbidity is generally very low in Star Gulch and its tributaries. Higher turbidities are associated with storm events and subsequent higher flows.

Table 15. Average and Maximum Grab Sample Turbidities for Star Gulch and Tributaries

	Star @ Gage	Benson Gulch	Light- ning Gulch	1917 Gulch	1916 Gulch	Ladybug Gulch	Alex- ander Gulch	Deadman Gulch	Star above Dead- man
Average Turbidity (NTU)	2.12	2.85	1.34	0.96	0.44	0.69	2.60	0.60	1.53
Maximum Turbidity (NTU)	55.3	72.0	25.1	33.1	5.31	29.0	34.9	11.3	16.0

Source: BLM data

Figure 7. Average Monthly Turbidity for Star Gulch



Sources: ELM data @ USGS Gaging Station and above Deadman Gulch

Trend

The water temperature trend in Star Gulch is reduced summer maximum water temperatures as riparian vegetation recovers. Water temperatures are likely to maintain the same pattern in the Applegate River due to withdrawals, high width/depth ratio, and lack of riparian cover. As water temperature decreases in Star Gulch, the pH and DO levels should increase. pH and DO levels are not expected to change in the Applegate River. Sedimentation and turbidity in the analysis area will probably stay at the existing level unless new road construction occurs (then it would increase) or roads are decommissioned (sediment and turbidity would decrease).

RIPARIAN AREAS

Applegate River

Along the Applegate River, the riparian area is relegated to a narrow band along the river banks, mostly within the active channel. Most of the trees are alder, with some maple, cottonwood, and conifers mixed in. Willow and other shrubs are common on bars, but introduced Himalayan blackberries dominate most of the riparian understory. The river is deeply incised and bedrock controls are common throughout this section. Many of the banks are sparsely-vegetated bedrock. There has not been an assessment of the impacts from the 1997 New Year's Day Flood.

In the Applegate-Star/Boaz Watershed Analysis Area, roads parallel the Applegate River on both sides. Because the river is entrenched through some of this section, the roads are on a high floodplain. Both of these roads limit the width of the riparian area. One county bridge crosses the river.

Star Gulch

Riparian condition is a high priority issue for maintaining or improving steelhead runs and cutthroat populations in Star Gulch (USDA and USDI 1995)..

The riparian area is well-vegetated. It shades the stream channel through most of its length, except where past logging removed trees on north-facing slopes. Most of the trees, both conifers and hardwoods, are young. There are only a few stands with large-diameter trees. Maples are the biggest-diameter trees along Star Gulch between the first bridge across Star Gulch and Benson Gulch. Most of the alder appears to be about 20 years old and they probably sprouted after the 1974 flood. Species composition is very mixed and includes maple, alder, Douglas-fir, ash, live oak, ponderosa pine, and cedar.

The riparian area lacks large woody debris (LWD). It is not capable of producing much LWD in the near future because of the lack of large diameter trees. In riparian areas, LWD helps slow down flood waters, provides important nutrients, stores water, maintains humidity, and provides "nursery sites" for young trees. Some salamander species use logs in riparian areas as cover, feeding areas, and nest sites (Corkran and Thoms 1996). Pacific giant salamanders (*Dicamptodon tenebrosus*) reside in Star Gulch and it is likely that several other amphibian species are also present.

Upstream of Alexander Gulch, Star Gulch Road crosses and runs along the south bank of the stream. Only a very thin strip of conifers remains between the road and the stream and there is an old clearcut on the other side of road. The riparian area has dried-out due to lack of vegetated cover.

The Star Gulch Road parallels Star Gulch from near the mouth to the headwaters in Section 27. The road crosses Star Gulch three times upstream of Ladybug Gulch. There are over 300 crossings on perennial, intermittent, and ephemeral channels, mostly in the Alexander, upper Star, Lightning, and Benson Gulch drainage areas (Appendix A, Table A2). Roads through riparian areas parallel the streams in Alexander, Ladybug, 1917, 1918, and Lightning gulches, and an unnamed tributary in Section 23. These roads reduce riparian habitat, limit the number of trees that fall into the streams, and decrease shading. Roads on south banks allow hot summer sun to penetrate areas raising air and water temperatures and reducing humidity.

Lime Gulch

Even though Lime Gulch is an east-facing drainage, and therefore, not as hot as a west-facing drainage, the riparian areas in Lime Gulch are relatively narrow. The same tree species mix that occurs in Star Gulch is present in Lime Gulch, they are maple, ash and conifers. Data is not available on riparian conditions, past history (e.g., mining), amphibian use, shrub condition, humidity, LWD, or other riparian area information within Lime Gulch.

Very few roads enter the Lime Gulch drainage area. Approximately one-quarter mile of road runs through the riparian area near the mouth. There are approximately 15 crossings on intermittent and ephemeral channels in the headwaters.

Boaz Gulch and Other Eastside Tributaries

Because the streams flow in a westerly direction, their slopes are either north or south-facing. As a result, the riparian areas are not symmetrical, extending upslope farther on the north-facing side than on the south-facing side. Riparian-dependent plants and trees are present in these drainages, but in a narrower band than is found in wetter, cooler streams. Also, upland vegetation like oak and *Ceanothus* is often intermixed, especially higher-up in the drainage. Data is not available on riparian conditions, past history (e.g., mining), amphibian use, shrub condition, humidity, LWD, or other riparian area information.

The only roads in the east frontal stream watersheds are in Boaz Gulch. A road runs up the middle portion of the Boaz Gulch riparian area for approximately one-half mile, crossing the channel twice. Fewer than eight road crossings are on intermittent and ephemeral tributaries to Boaz Gulch and the Applegate River.

The Boaz Gulch drainage area is in a grazing allotment. BLM has not documented any cattle impacts to streams or springs, although serious cattle impacts are unlikely. When the cattle are on the Boaz side of the ridge, they tend to concentrate at the bottom of the slope near the irrigation ditch. Later in the year, the cattle are moved through Boaz over the ridge into the Little Applegate River Watershed. They do not tend to congregate for any length of time in the Boaz Gulch drainage (Stevens 1996).

AQUATIC WILDLIFE SPECIES AND HABITATS

Star Gulch is one of eight tributaries with the healthiest fish populations in the Applegate River system. The other tributaries (downstream to upstream) are Slate, Cheney, Williams, Beaver, Palmer, and Yale creeks, and the Little Applegate River. Star Gulch is the first tributary upstream of Williams Creek that provides good fish habitat. The tributaries between Williams Creek and Star Gulch have been heavily impacted by hydraulic mining and roads.

Although little is known about fish movement in the Applegate system, it appears that tributaries, like Star Gulch, are critical for all fish species. The Applegate River is too warm, harbors predators such as introduced bass, and lacks complex habitat for young fish.

Therefore, survival of young fish may be better in the tributaries. Although larger fish may rear in big pools, the Applegate River probably functions primarily as a migration corridor.

Summer Rearing Habitat

Summer fish habitat provides places for fish to hide from predators, avoid competitors, and acquire enough food to make it through the winter and spawn the following spring. Slow water areas, which include pools and glides (shallow pools), provide the best summer habitat. Fish do not have to expend precious energy swimming against the current because velocities are slow. Slow water is extremely important for newly-hatched and juvenile fish. Newly-emerged salmon fry (20-35mm long) select velocities of less than 10 cm/sec (Everest and Chapman 1972; Moyle and Baltz 1985). However, most aquatic insects live in riffles and are a good food source for all ages and species of fish. Therefore, a diverse combination of food-producing riffles and energy-saving, safe pools provides the best summer-rearing habitat.

Applegate River

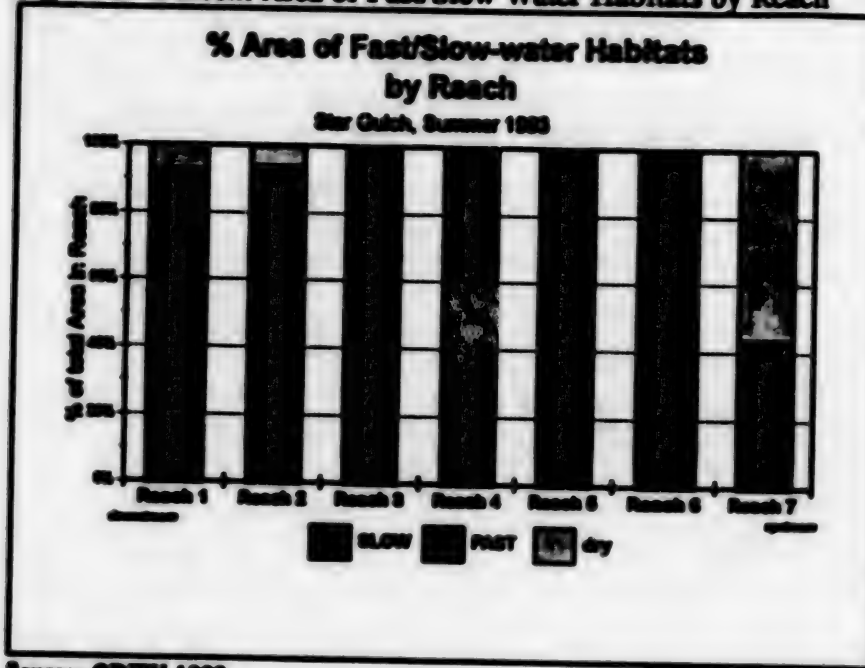
Summer habitat data is not available for the Applegate River. In general, the river is wider and shallower than it used to be. Backwaters and side channels are almost nonexistent and the once extensive beaver marshes are gone. Dikes and roads confine the channel and homes line the banks. Pool habitat has probably been drastically reduced from historical levels.

Star Gulch

In Figures 8-20, Star Gulch is divided into seven sections or "reaches." Each reach comprises the following portions of Star Gulch. Reach 1: the mouth to the first Star Gulch Road bridge. Reach 2: the first Star Gulch Road bridge to Benson Gulch. Reach 3: Benson Gulch to Lightning Gulch. Reach 4: Lightning Gulch to 1917 Gulch. Reach 5: 1917 Gulch to Alexander Gulch. Reach 6: Alex Gulch to Deadman Gulch. Reach 7: Deadman to last road crossing in mainstem Star Gulch (end of survey).

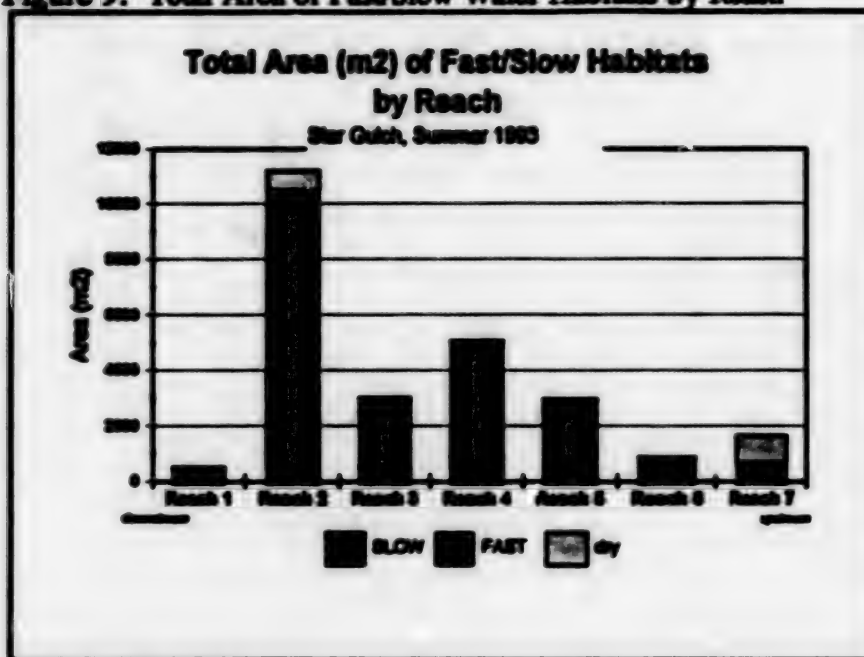
Star Gulch has very low pool to riffle ratios, with 20 percent or less slow water (Figure 8). Most of the slow water is shallow, which does not provide much protection from predators. Most of the total area of pool habitat is in Reach 2, between the first Star Gulch Road bridge and Benson Gulch (Figure 9), mainly because the stream is wider and the area of the pools is greater, and also because the reach is somewhat longer than the others.

Figure 8. Percent Area of Fast/Slow Water Habitats by Reach



Source: ODFW 1993

Figure 9. Total Area of Fast/Slow Water Habitats by Reach



Source: GDFW 1993

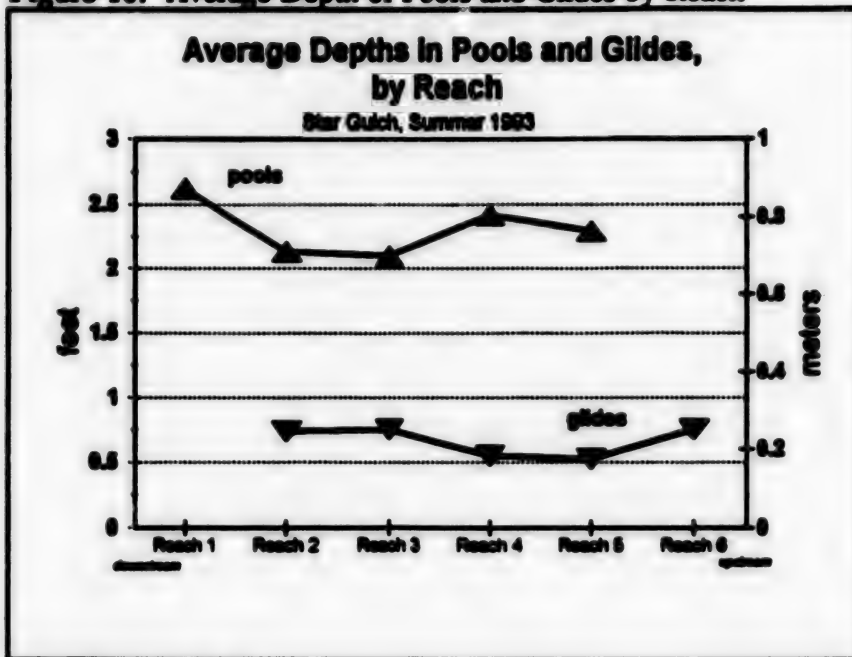
Moving upstream, the proportion of cascades (steep, boulders or bedrock rapids) increases. The upstream reaches, from 1917 Gulch to the headwaters, are almost all cascades. Cascades sometimes have small plunge pools, but essentially, they are fast water. Cutthroat trout seem to use these small pools, which allows them to occupy areas farther upstream in the watershed than steelhead (Map 13). Adult cutthroat can handle faster velocities than juvenile steelhead.

Winter Habitat

Many fisheries biologists think that winter habitat is the primary limiting factor for most fish, especially for salmonid species that spend several years in freshwater. Fish have a variety of strategies to deal with winter temperatures and high water velocities. In general, small fish seek shelter in the small interstitial spaces between cobbles and boulders. They hide under logs and undercut banks or in backwater areas and side channels. Larger fish may join together in schools and move long distances to find suitable winter habitat (Bjornn and Reiser 1991). Small fish may move if winter habitat is not available.

The best winter habitat is provided by deep pools with boulders and cobbles, and no fine sediments. Glides are unusable as winter habitat because they become fast-water areas in the winter (USDI 1996a). Figure 10 illustrates the difference between average depths in pools and glides. Deep backwaters, over hanging banks, and areas under and within stable log jams also provide good winter cover, especially for larger fish.

Figure 10. Average Depth of Pools and Glides by Reach



Source: ODFW 1993

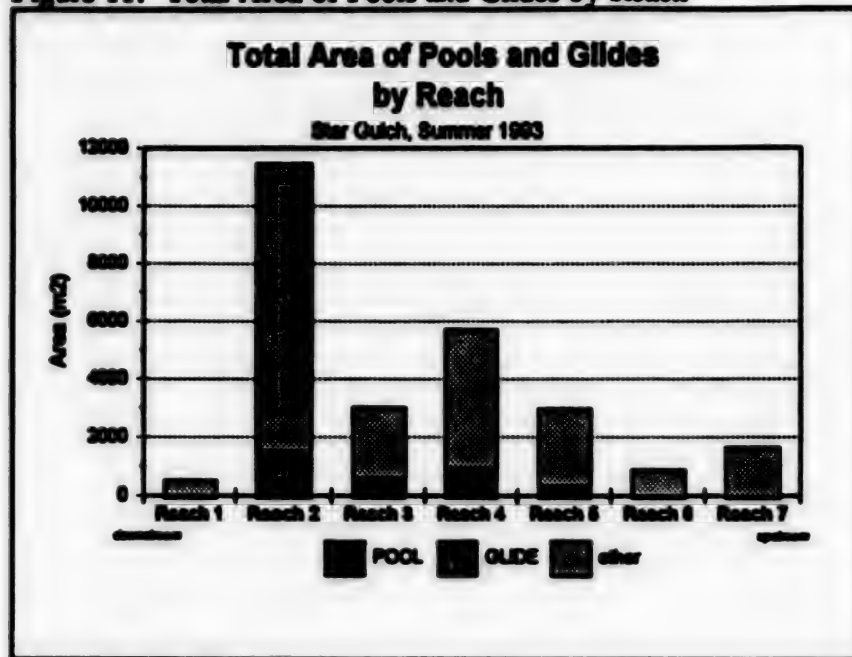
Applegate River

Winter habitat data is not available for the Applegate River. It is possible that juvenile steelhead move out of Star Gulch to overwinter in the Applegate River since there is not enough winter habitat in the stream. If they move, it is unlikely that they return to Star Gulch before they migrate to the ocean two years later, because the mouth of Star Gulch is steep and difficult for small fish to access.

Star Gulch

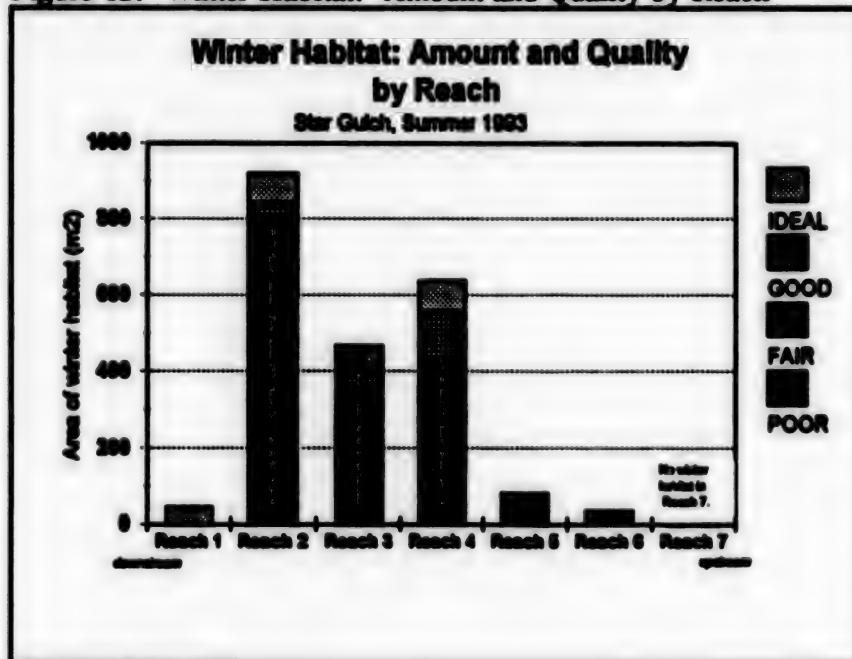
Winter rearing habitat in Star Gulch is very limited. Deep pools provide the most secure winter habitat and the amount of deep pool areas are very limited (Figure 11). Shallow pool areas (glides) are more common, but in short supply. Pool depth, sediment size, the amount of boulder cover, and several other factors were evaluated from the 1993 stream survey data for each pool in Star Gulch. These factors were combined to construct "Excellent", "Good", "Fair", or "Poor" winter habitat quality ratings.

Figure 11. Total Area of Pools and Glides by Reach



Source: ODFW 1993

Figure 12. Winter Habitat: Amount and Quality by Reach



Source: ODFW 1993

Reaches 2, 3, and 4 (from the first Star Gulch Road bridge to 1917 Gulch) contain most of the winter habitat in Star Gulch because they contain most of the pools and glides (Figure 11). Only a small portion of this winter habitat can be considered "Good" or "Excellent" (Figure 12). Most of the habitat is rated "Fair" or "Poor," either because the pools contain large amounts of fine sediments or bedrock, or they are too shallow and are likely to provide little protection from swift winter flows.

Very little winter habitat in Star Gulch is available in Reaches 1, 5, and 6 (Figure 12). Reach 1 is shown on Figure 12 as being ideal. These reaches are steeper, cascade-dominated, and have few pools. Reach 7 does not contain any winter habitat.

Instream Cover

Cover is a key component of both summer and winter habitat quality. Cover provides security from predation and high water velocities, allowing fish to occupy areas they might not otherwise use (Bjornn and Reiser 1991). Overhanging vegetation, logs, extra depth, rocks, piles of branches, even single sticks are all used by fish as cover.

Trout key into cover as protection from predation, but also because they are very territorial. They defend their territories against other fish that might compete for food. Complex underwater cover (e.g., branches) visually isolates trout from one another, reducing the size of their territories and usually increasing the number of fish that might occupy a pool or space (Dolloff 1983). Cutthroat and steelhead abundance has been correlated with the abundance and quality of cover (Bjornn and Reiser 1991).

Applegate River

Data is not available for the Applegate River, but cover is probably limited. Pools are probably deep enough that depth alone provides cover for adult steelhead and salmon, although little visual isolation. In riffles, rocks and turbulence probably provide most of the cover. Fallen alders and other bank vegetation provide cover along the bank, but in many areas along the river, blackberries predominate and provide little cover.

The substrate likely provides excellent cover for sculpin, which are camouflaged against the substrate. Adult Klamath smallscale suckers probably use the big, deep pools during the day (Rossa 1998). It is unknown how the amount of cover, or lack of it, in the Applegate would favor or hinder exploitation by introduced fishes like bass.

Star Gulch

Instream cover data is not available, but certain kinds of cover are abundant and others probably are limited. Turbulence and substrate in riffles and cascades probably provide most of the cover. Although limited, some pools have overhanging vegetation, or are deep, or both. See the Large Woody Debris section for further information on this form of cover.

Spawning Habitat

Trout and salmon spawn in gravels and small cobbles in pool "tails", which is the downstream end of the pool where it becomes shallow before changing into a riffle. In the pool tail, water is actually forced through the gravels, bringing oxygen to the embryos and carrying away their metabolic wastes. The gravels must be free of fine sediments that might reduce this water flow. If the embryos consume oxygen faster than the intragravel water can replace it, they will asphyxiate. Fines can also cause problems if they fill the spaces between the gravels and

prevent the newly-hatched fish from moving out of the nest, or redd.

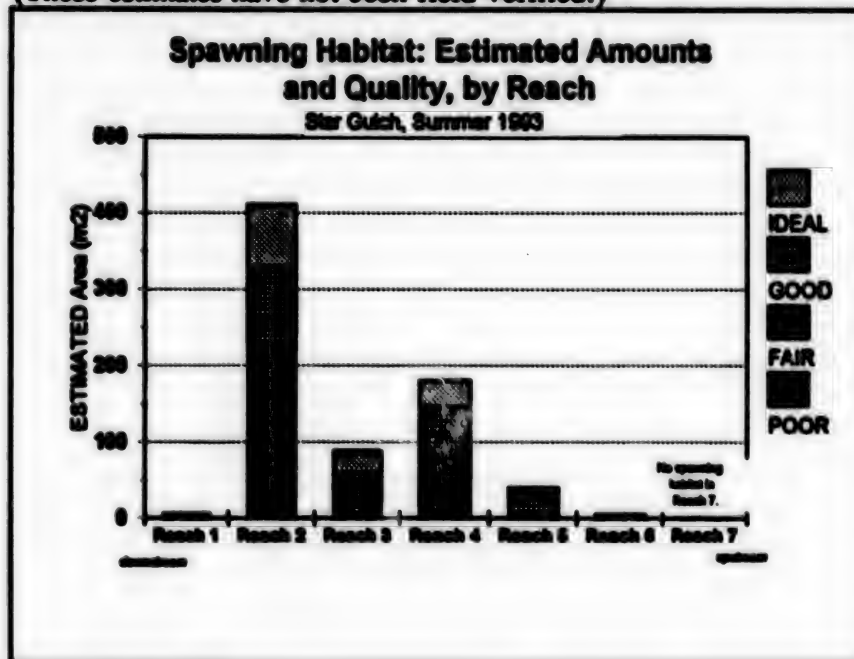
Applegate River

Spawning habitat data is not available for the Applegate River. It is likely that spawning gravels are in short supply in the stretch of river between the dam and the Little Applegate River. Most of the erodible rock sources for the Applegate River are above the Applegate Dam (USDA and USDI 1995). Historically, the tributaries above Applegate Lake probably provided more gravels and cobbles than the tributaries downstream. All of the gravels and cobbles from upstream tributaries are trapped behind the dam, leaving the downstream tributaries to provide all of the spawning materials. The downstream tributaries will provide gravel, but more slowly, which may not be at a rate fast enough to replace gravels moved downstream.

Star Gulch

BLM does not have recent data on the amount or quality of spawning gravels in Star Gulch and its tributaries. However, estimates of spawning gravel amounts and quality obtained from pool and substrate information are provided in Figure 13.

Figure 13. Spawning Gravel Estimates: Amount and Quality by Reach
(These estimates have not been field verified.)



Source: ODFW 1993

Reach 2 has more pool and glide habitat and has a slightly lower gradient than other reaches, therefore, it probably contains most of the spawning gravels. However, many of the pools and glides in Reach 2 contain large amounts of sand, therefore the quality of the spawning areas is questionable. Reaches 3, 4, and 5 have fewer gravels, but they contain less fine sediments,

thus the gravels are of higher quality (Figure 13).

Large Woody Debris

Large woody debris (LWD) (all or portions of large-diameter trees that have fallen into the stream channel) have both physical and biological consequences for fish habitat. Wood pieces frequently create a stepped channel profile: short wood-created falls that alternate with low-gradient pools. This gives a large portion of the stream a lower gradient, more pools, and more acceptable spawning and rearing habitat than might otherwise be available. In steep-gradient systems, LWD is essential for trapping spawning gravels. Without LWD, boulders and pools formed by bedrock would be the only elements creating depositional areas for gravel.

Besides retaining spawning gravels, LWD also traps organic matter (e.g., fallen leaves and branches) enabling bacteria and fungi to process it and incorporate it into the food chain (Triska et al. 1982). The extensive storage capacity provided by LWD increases a stream's overall productivity, which is usually translated into a healthier and more numerous fish populations.

Different species of downed trees last longer in water than others. For example, Douglas-fir decomposes slower than pine or hardwoods. Thicker pieces require greater discharges to move, withstand heavier impacts and static loads, and resist decay longer (Pitlick 1981). Short pieces can stabilize narrow channels, but the wider the stream channel, the longer the log has to be to remain stable and provide long-term improvements in habitat complexity. The rule of thumb is that the length of LWD needs to be twice the width of the channel at bankfull flows (the discharge at which the stream leaves the channel and goes onto the floodplain, which occurs every 1.5 to 2.0 years).

In general, LWD does not play a big role in creating and sustaining mid-channel fish habitat in large rivers. Logs are often not long enough to span the channel and create pools (Swanston 1991). However, high flows deposit woody material along the channel margins, where it often forms the most productive fish habitat in mainstem rivers (Bisson et al. 1987). High flows also deposit logs on floodplains where they serve to slow the water down during subsequent flood events, create slow-water refuges during high water events, and provide habitat for riparian animals and plants during the summer.

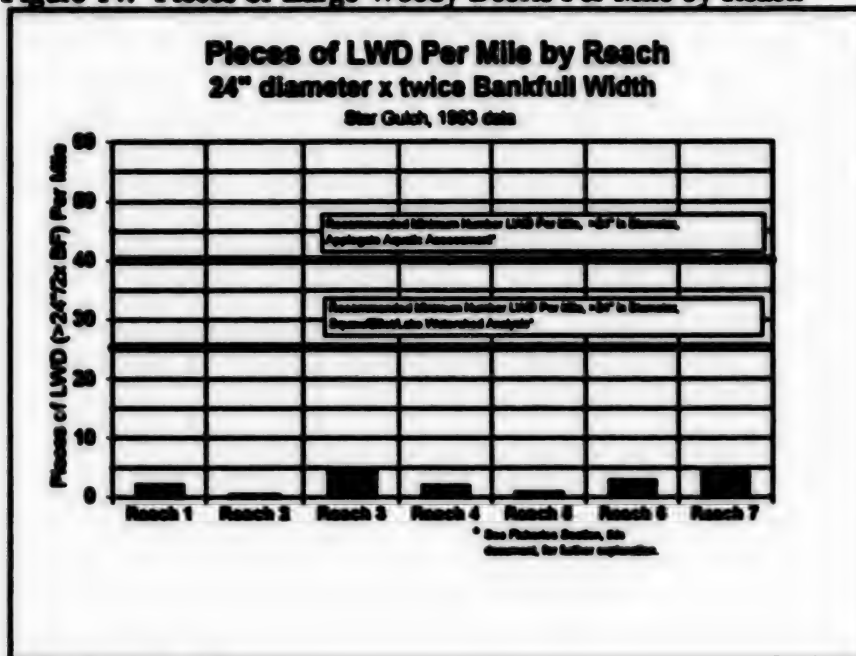
Applegate River

The Applegate River has very little woody material. Over the years, various agencies and residents have pulled most of the logs out of the river during flood clean-up and damage prevention efforts. Agencies and residents are concerned about debris jams piling up on private property, damaging buildings near the channel, damaging bridges, or diverting the river and causing bank failures. Where possible, logs and debris jams should be left on banks and in the river to provide fish habitat.

Star Gulch

According to criteria recommended by the Applegate River Watershed Assessment (USDA and USDI 1995) and the Squaw-Elliott Watershed Analysis (USDA 1995), Star Gulch has inadequate amounts of LWD (Figure 14). The Applegate River Watershed Assessment recommends that streams in the Applegate should have 40 to 150 pieces of 24" LWD/mi. The Squaw Elliott Watershed Analysis recommends that streams have 25-75 pieces of 24" wood/mi. Star Gulch has less than five 24" pieces/mi. in each reach (Figure 14).

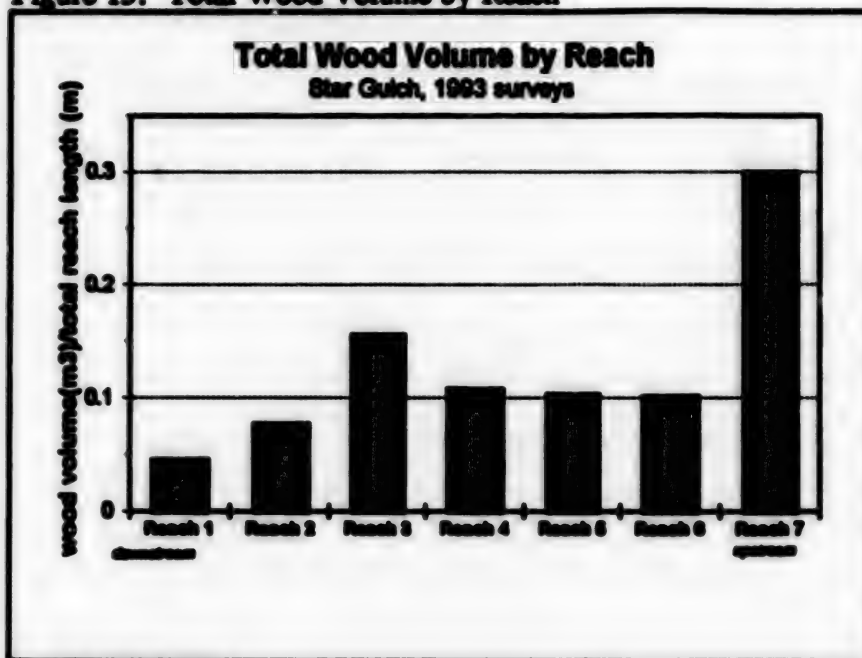
Figure 14. Pieces of Large Woody Debris Per Mile by Reach



Source: ODFW 1993

The 1993 surveys in Star Gulch (ODFW 1993) measured and counted all wood pieces 6" and above in diameter, regardless of the length of the piece. Figure 15 presents these data as volume per reach length. Most of the wood volume is in Reach 7, the farthest upstream section. Reach 7 has over twice the wood volume per reach length than the other reaches. Reach 3, Benson Gulch to Lightning Gulch, also has more wood volume than other reaches. Reach 3 has the smallest average volume per piece of wood (Figure 16) indicating that all of the wood is small. Wood in Reach 7 has a larger average volume per piece of wood.

Figure 15. Total Wood Volume by Reach



Source: ODFW 1993

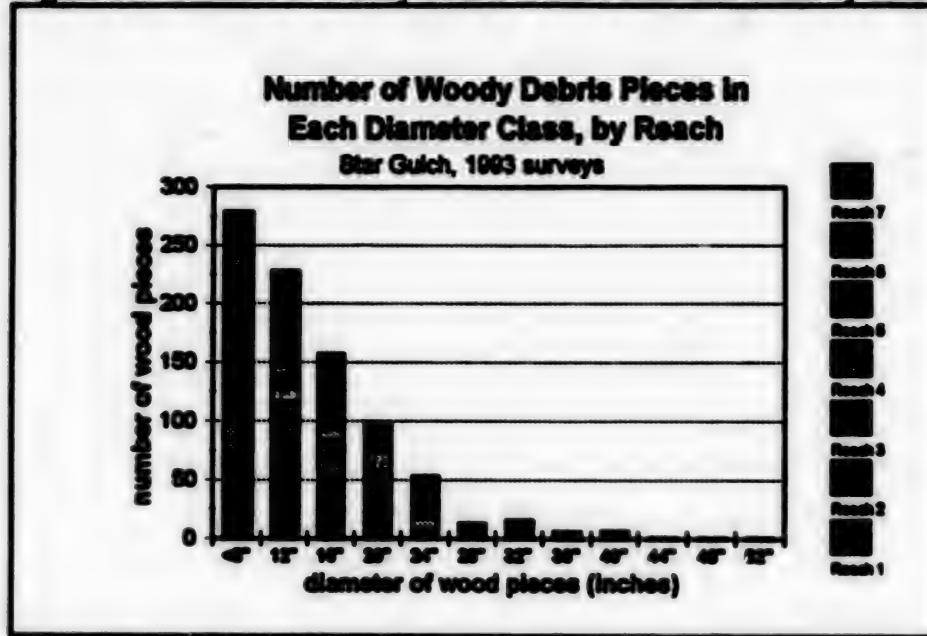
Figure 16. Average Volume/Piece of Large Woody Debris by Reach



Source: ODFW 1993

Another way to look at the size of the wood in Star Gulch is to divide it into diameter classes. Figure 17 presents the number of wood pieces in Star Gulch. The counts from each reach are "stacked" upon each other in each column. (Note: almost all of the wood is less than 16" in diameter, which is far less than the 24" recommended for long-term fish habitat improvement.)

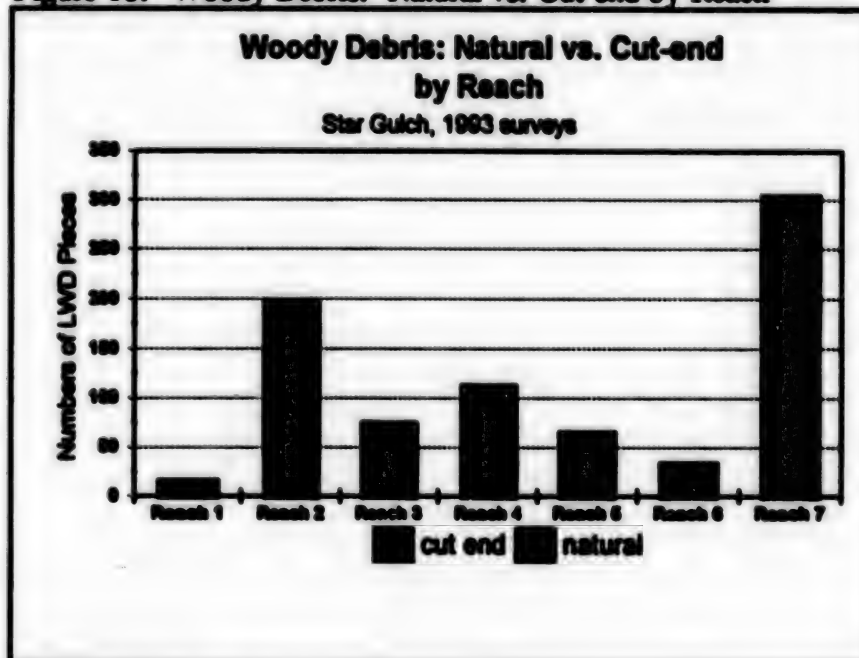
Figure 17. Number of Woody Debris in Each Diameter Class by Reach



Source: ODFW 1993

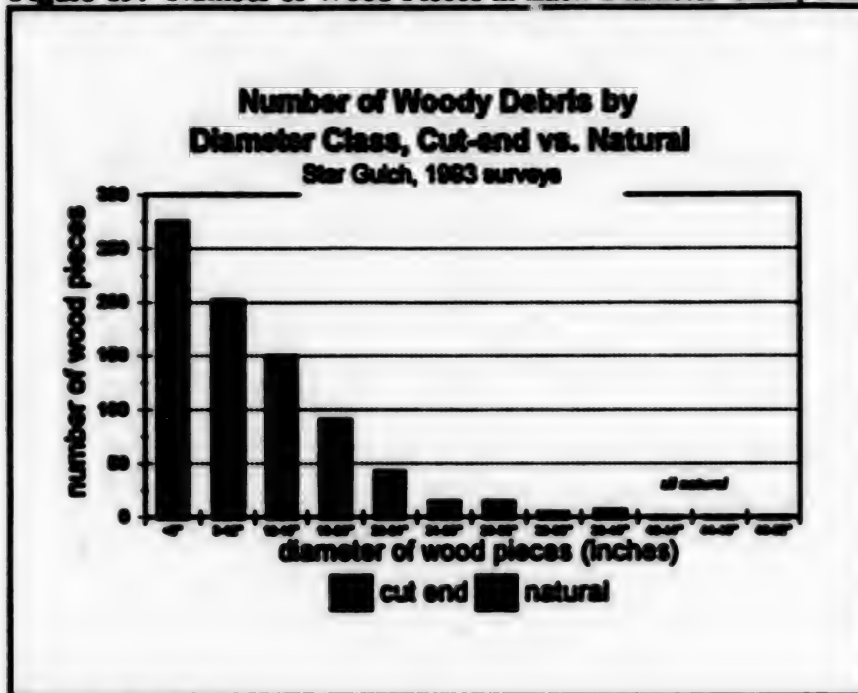
Most of the wood in Star Gulch has fallen into the stream naturally (Figure 18). In Reach 7, almost half of the pieces have a cut (sawn) end, indicating they are from logging. Most of these cut-end pieces in Reach 7 are less than 8" in diameter (Figure 19). Reach 5, which has had no riparian harvesting, has cut end logs in the creek. High flows have probably moved them downstream from Reach 6 or Alexander Gulch.

Figure 18. Woody Debris: Natural vs. Cut-end by Reach



Source: ODFW 1993

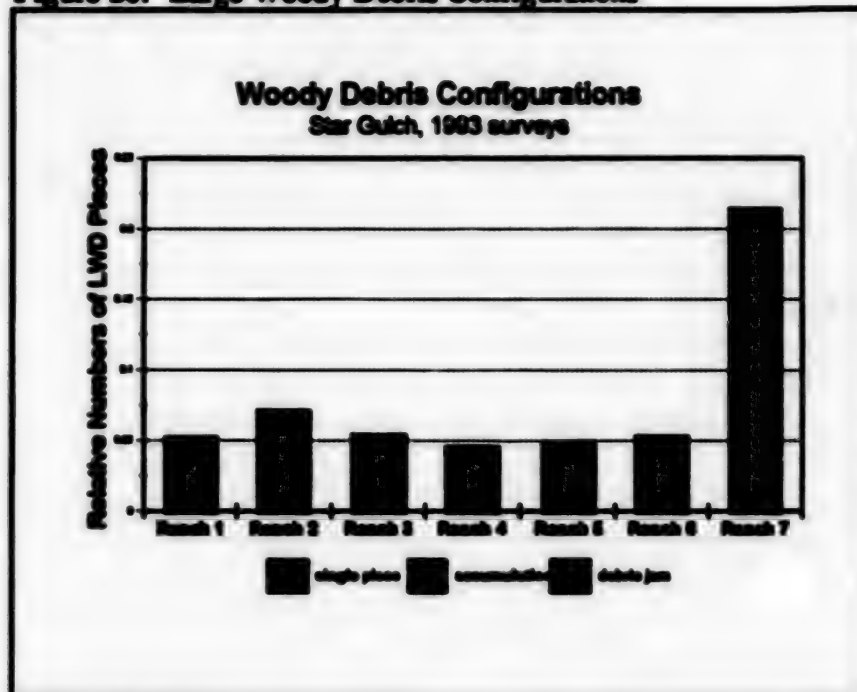
Figure 19. Number of Wood Pieces in Each Diameter Class, Cut vs. Natural by Reach



Source: ODFW 1993

Most of the wood in Star Gulch is stuck in loose debris jams (Figure 20). Star Gulch is a steep stream system; short or small-diameter wood moves easily in high flows and accumulates in piles. Since most of the wood in Star Gulch is less than 16" in diameter, the frequency of debris jams is high. Occasionally, jams can be a fish passage problem, usually in low-flow years. There are usually many places where water flows through the logs and fish can easily pass. It is uncommon for a debris jam to cause long-term problems. None of the debris jams in Star Gulch were noted as causing fish passage problems (ODFW 1993). No assessment of the impacts of the 1997 New Year's Day Flood have been made.

Figure 20. Large Woody Debris Configurations



Source: ODFW 1993

In the 1980s, BLM placed log weirs in Reach 2 to improve spawning and summer rearing habitat. Over the years, the weirs began to fall apart. In 1995, an above average water year, four structures had no flow over the top of the log (essentially fish barriers) and water percolated underneath the log and through the gravels. Another four structures need jump pools improved or log sill notches enlarged to help juvenile fish pass over the structure. In 1997, BLM repaired or removed these structures.

Turbidity

When turbidity is high, trout and salmon cannot feed because they rely on their eyes to find food. Berg and Northcote (1985) reported that feeding and territorial behavior of juvenile coho salmon were disrupted by short-term exposures (2 ½ to 4 ½ days) to water measuring up to 60 NTUs (Nephelometer Turbidity Units). Long-term exposure to high turbidities may affect growth. Newly emerged fry are more susceptible. High turbidities irritate their gills, making it difficult for them to breathe. Long-term exposure to turbidities in the 25 to 50 NTU range reduced growth in juvenile coho (Sigler et al. 1984). Juvenile salmonids tend to avoid streams that are chronically turbid, such as glacial streams or those disturbed by human activities (Lloyd et al. 1987), except when the fish have to traverse them along migration routes.

Applegate River

Turbidity data is not available for the portion of the Applegate River in the analysis area.

Star Gulch

The turbidity data reported in the Water Quality section reports average and maximum turbidity levels using 15 years of grab sample data and the average monthly turbidity levels from 14 years of data. The averages are very low (less than 3 NTUs). The high maximum levels are a response to storms when water flows off of roads and disturbed soil surfaces, producing short pulses of high turbidity levels. These storm events might temporarily disturb feeding and territorial behavior (Berg and Northcote 1985). However, most storm events in Star Gulch occur during the winter months when fish are inactive. After a storm is over, the high turbidity levels drop off very quickly to levels well below those that might cause a problem for trout.

Suction dredge mining may cause elevated local turbidities, but BLM does not have any data that corresponds with known times of suction dredge operations in Star Gulch. Critical times to protect steelhead and cutthroat would be in late spring when the newly-hatched fish have emerged.

Temperature

As mentioned in the Water Quality section, the State Department of Environmental Quality (DEQ) water temperature limit for cold-water fish species is 64°F. If a stream reaches temperatures above 64°F, DEQ classifies it as "water quality limited" because of temperature.

A large body of scientific research shows that cold-water species, like cutthroat and steelhead, do not do well in water temperatures above 64°F. Although fish may survive at higher temperatures, they become physiologically stressed. Higher water temperatures increase a fish's metabolism, speeding up all of its body functions. Because of this higher energy demand, a fish must use most or all of the food it consumes for maintenance, and very little is left over for growth (Bjornn and Reiser 1991). Often small streams are not particularly productive, that is they do not produce large amounts of fish food, so increased temperatures cannot be translated into faster growing, bigger fish. Fish also become more susceptible to disease and parasites at warmer temperatures.

Applegate River

As mentioned in the Water Quality section, water temperatures in the Applegate River immediately below the Applegate Dam remain below 64°F, the State temperature criteria for cold-water fish. In fact, summer water temperatures generally stay below 60°F (Figure 5). In 1994, temperatures slowly rose above 60°F twice, and then suddenly dropped almost 10° to just above 50°F. These sudden temperature changes were probably due to increases in flow release from the dam.

The cool temperatures may be especially important because the rest of the Applegate River is abnormally warm. The water warms up rapidly after it leaves the dam, so that by the time the river reaches the confluence with the Little Applegate River, maximum water temperatures are already in the high 60s and low 70s, which is very warm for salmonid fish species and sculpin.

This puts pressure on the limited amount of summer rearing habitat available in the river canyon below the dam.

In general, the cool temperatures are good for rearing steelhead and coho, although the sudden temperature drops may be physiologically stressful. It is unknown how the other native Applegate species, the Klamath smallscale suckers, two lamprey species, and reticulate sculpin, are affected by the lower temperatures. Because the unusually high summer water temperatures (over 70°F) in the Applegate River are generally thought to be due to a combination of low water flows (both natural and due to irrigation withdrawals), reduced riparian vegetation cover, and increased channel width to depth ratio (channel wider and shallower), it is likely that the cooler temperatures mimic what was present in the system before European intervention. Therefore, for summer conditions, the cool temperatures combined with regular flows from the Applegate Dam have probably improved the situation for fish through the stretch of the Applegate just below the dam.

Altered flows and temperatures from the Lost Creek Dam on the Rogue River have changed the timing of salmon and steelhead fry emergence, fish distribution in the river, and adult migration and mortality (Cramer et al. 1985). Effects of the Applegate Dam have not been thoroughly investigated.

Star Gulch

In 1995, maximum temperatures near the mouth of Star Gulch exceeded State water quality standards on 48 days. The highest maximum temperatures in both July and August were 68.9°F (Appendix B).

Warm temperatures are recorded all the way upstream past Lightning Gulch. Both Lightning Gulch and Benson Gulch contribute cold water all summer (maximum temperatures approximately 61°F), so the warming appears to occur on Star Gulch (Appendix B).

Dissolved Oxygen

Dissolved oxygen (DO) must be above a critical level for fish to exist in a stream (Bjornn and Reiser 1991). Different fishes have different DO requirements. Cold-water fishes generally require higher DO concentrations than warm-water fishes (e.g., bass or bluegill). Davis (1975) concluded that for salmonids, initial distress symptoms of DO deprivation would occur at approximately 6 mg. oxygen/liter, which equals 72 percent saturation at 25° Centigrade.

Applegate River

Dissolved oxygen data is not available for the section of the Applegate River within the analysis area. Directly below the dam, DO concentrations are probably adequate due to the cool summer water temperatures. However, if the water is released from the bottom of the reservoir, it may have very low DO concentrations. Downstream, as the river approaches the confluence with the Little Applegate River, summer DO levels probably decrease with increasing water temperature and may reach conditions that cause stress or reduce growth in

fish.

Star Gulch

As mentioned in the Water Quality section, DO measurements never fell below 8.8 mg/l from May to October during 1983, 1984, and 1985. Therefore, Star Gulch probably never reaches the low DO conditions that could cause stress or reduce growth in fish.

Macroinvertebrates

Macroinvertebrates populations vary within the Star Gulch drainage (Table 16). Populations in Alexander Gulch and Upper Star Gulch have higher diversity than the other sites and high to moderate numbers of positive indicator species (species that only live in streams with good water quality). Overall, macroinvertebrate abundance is lower in Upper Star than in Alexander, but it is not uncommon to see low numbers of insects in small headwater areas. Macroinvertebrate populations in the other streams indicate 'less healthy' streams. Diversity is low, indicating that only a few species dominate the community, and positive indicator species are few or nonexistent, suggesting that water quality is impaired. All of the streams in Star Gulch have embedded cobbles, where fines have filled in the crevices between the rocks. This decreases aquatic insect habitat.

Table 16. Variables Describing Aquatic Macroinvertebrate Populations and Habitat in Star Gulch and its Tributaries, Autumn 1996

Stream ¹	Total MI Abundance	Total Species Richness	Dominant Species	EPT Richness	Negative Indicator Species	Positive Indicator Species	Habitat Problems
Upper Star	Low/Mod	Mod/High	<i>Isonodes</i> (scraper, early wood colonizer)	Mod/High	Low	Mod	Mod CE
Alexander	High	Mod/High	None	High	Low	High	Mod CE
Ladybug	Low	Mod/Low	None	High/Mod	None	Low	Mod/High CE, especially in pools; high flow events often rescut substrate; in places, stream shifted to bedrock or retreats underground.
Lightning	High	Low	<i>Isonodes</i> (scraper, early wood colonizer)	Mod	None	Low	Mod/High CE, especially in pools; periodic rescutting of substrate; high levels of scour.

Stream ¹	Total MI Abundance	Total Species Richness	Dominant Species	EPT Richness	Negative Indicator Species	Positive Indicator Species	Habitat Problems
Benson	Low/Very Low	Low	<i>Ironodes</i> (scraper, early wood colonizer)	Low	None	Low	High CE, especially in pools.
Lower Star	High	Low/Mod	<i>Ironodes</i> (scraper, early wood colonizer)	Mod/High	None	None	Mod CE; periodic resorting of substrate; high levels of scour.

¹ Sites are listed upstream to downstream. MI: Macroinvertebrate, Richness: a variable describing diversity, CE: Cobble embeddedness (how deeply cobbles are buried in fine sediments), EPT: Ephemeroptera/Plecoptera/Trichoptera, Mod: Moderate. Data from Schroeder (1996).

In four streams, *Ironodes*, a mayfly, dominates the population. *Ironodes* colonizes fallen wood, scraping off algae and fungi as the wood begins to decompose (Merritt and Cummins 1984). High numbers of *Ironodes* suggest there is a lot of wood at these sample sites. Wood is important habitat for aquatic insects, especially in small steep streams that experience scouring and bed movement (Merritt and Cummins 1984). Many of the streams in the Star Gulch drainage show signs of scouring and bedload movement during high flows.

Fish Barriers

Barriers such as dams, irrigation diversions, debris jams, or natural water falls can block passage of both adult and juvenile fish. Small barriers passable by adult fish may block juvenile movement either upstream, limiting their habitat range, or block their downstream migration. Larger barriers can also prevent adults from reaching spawning habitat or reduce the amount of habitat available to resident fish.

Applegate River

There are no barriers to juvenile or adult fish within the Applegate-Star/Boaz Watershed Analysis Area section of the Applegate River.

Star Gulch

The mouth of Star Gulch was a natural steep drop over bedrock, which was probably historically a barrier to both juvenile and adult fish, including steelhead. A fish ladder was constructed in 1974, providing access to spawning habitat for adult steelhead. Annual spawning surveys begun in 1980 show a high variability in the number of steelhead that spawn, with redd counts varying from 0 to 158. The fish ladder is not a barrier to juvenile steelhead moving downstream into the Applegate River; however, it does prevent them from returning into Star Gulch.

Aquatic Wildlife Species and Habitats Summary

The Applegate River has little vegetative cover for fish, few backwaters and side channels, and inadequate large woody material. Pool habitat is also limited. The Applegate Dam probably prevents adequate spawning gravels from moving downstream, however, it does provide cool water to keep temperatures in this section well below the State temperature criteria of 64°F. There are no barriers to juvenile or adult fish within the Applegate-Star/Boaz Watershed Analysis section of the Applegate. Although larger fish may rear in big pools, the Applegate River probably functions primarily as a migration corridor.

Star Gulch has one of the healthiest fish populations in the Applegate River system. A fish ladder constructed in 1974 provides access for adult steelhead to spawn and allows juveniles to move out of Star Gulch (although not back in). Spawning gravels appear adequate. The pool to riffle ratio is low resulting in less protection for fish from predators in the summer and little winter rearing habitat. Most of the trees are young, so there is a lack of large woody material. Maximum stream temperatures exceed State water quality standards, although dissolved oxygen concentrations remain above concentrations necessary to maintain healthy fish.

REFERENCE CONDITIONS

The purpose of the Reference Conditions section is to explain how past human activities and natural disturbances have influenced current conditions in the Applegate-Star/Boaz Watershed Analysis Area. This section provides a reference for comparison with Current Conditions.

HUMAN USES

Native Reference Ecosystem

Landscape conditions in the Applegate-Star/Boaz Watershed Analysis Area have varied through time reflecting fluctuations in natural forces and changes due to human action. The native reference ecosystem refers to landscape conditions that prevailed just prior to the influence of western civilization; these conditions reflected the actions of native people, who used a variety of techniques to manage the land. Western civilization reached southwestern Oregon early in the nineteenth century bringing many changes to the land. In a recent report, Pullen (1996) reviewed the documentary record and constructed a model of the ecosystem as it existed in the early 1800s. This model indicates the following conditions.

1. Riparian areas were heavily timbered, primarily with conifers; ponderosa pine was prevalent along the Applegate River. Dense brush and thickets of willow occurred at the waters edge and downed logs were common.
2. Valley floors were regularly burned by native people. Burning promoted open prairies, groves of oak, and scattered ponderosa pine, and suppressed chaparral.
3. Valley slope vegetation reflected the influence of natural and human-caused fire. North-facing slopes were covered with open stands of ponderosa and sugar pines, with an occasional Douglas-fir. South-facing slopes were grassy, with oaks, chaparral, and scattered ponderosa pine in ravines.
4. Mid-elevation forests were less affected by human action and were covered with fairly uniform, mature coniferous forests with bushy understories. Oak and chaparral dominated the south-facing slopes and north-facing slopes were heavily timbered. Natural fire cycles of 10 to 20 years had more effect than fires set by people.
5. Upper elevations were characterized by a high diversity of environmental zones, with prairies, brushfields, downed logs, and open stands of pine, fir, and cedar. Many animals flourished, and native people used this zone intensively. Human-caused fires helped promote and enhance the resources of this zone.
6. Deer, elk, bear, small mammals, and predators all flourished. Native burning promoted a highly diverse landscape with many ecotones, which provided good habitat

for these species.

7. Beaver were abundant along the Applegate River and salmon and steelhead populations were extremely high.

The Applegate-Star/Boaz Watershed Analysis Area contains the first four zones noted above, as well as a segment of the Applegate River and several tributaries.

Archaeological evidence points to significant use of the watershed by native people. It is inferred that those actions that characterized the land management techniques of native people were also operative in the analysis area. These actions, especially native burning, would have had the strongest effects upon the lower elevations of the analysis area. Higher slopes, in the westernmost part of Star Gulch, would have been less affected (see Vegetation for historical condition).

With the advent of miners and settlers to the region in the 1850s, major conflicts arose between the native people and the new-comers. Skirmishes and battles continued up and down the Applegate Valley, including Star Gulch. A treaty with various bands of Rogue Valley Indians was signed on September 10, 1853 and ratified in 1855.

Early Historic Conditions 1830-1900

The historic period began with the arrival of nonnative people during the early 1800s. The landscape entered by these Euro-American explorers was already a product of the interplay between natural and human factors. With the advent of these foreign people, a very different and dynamic set of human actions brought rapid changes to the land.

The earliest effects upon the land probably came with the fur-trappers in the period between approximately 1830 to 1850. Beaver were largely eliminated in the region, and their absence may have affected the hydrologic regimes of local streams.

Discovery of gold and the subsequent invasion by hordes of miners from all over the world brought major changes to the analysis area. Miners were present up Star Gulch as early as the 1850s (Walling 1884; McKinley and Frank 1996). Hydraulic mining, with its intensive assault on natural landforms and hydrologic regimes, arrived at the analysis area in the later half of the nineteenth century. A homestead claim of 1911 notes that "this land has been prospected thoroughly in years past and the old creek channels have been placer mined rather extensively. No quartz mining has been done . . . considerable placer gold was obtained from the old channels in Star Gulch." This same claim has a map showing the stretch of the Applegate River and lower portions of Star Gulch as "mined out," with placer claims noted in the western part of the analysis area.

Settlers accompanied the miners, and by 1857, all level land in the analysis area was settled, primarily along the Applegate River (Black and Black 1990), and by 1884, at least two settlers were established up Star Gulch (1884 GLO survey plat). Farming and ranching characterized this new way of life. A road was opened along the Applegate River in the 1870s, and a trail

extended up Star Gulch as far as Section 13. Federal land policies extended even to this remote corner of the American west, as alternate sections of land were withdrawn from the public domain to help finance building of the Oregon-California (O&C) railroad.

A considerable amount of white oak and madrone fell to the prospector's axe for firewood during the gold rush period. Local miners and settlers found ponderosa and sugar pine to be the most valuable timber species. Pine was cut for flume boards and sluice boxes, as well as for roofing shakes and other lumber.

The nineteenth century incursion of new people brought major changes to the landscape. Mining affected the streams and river, changing fish habitat and eliminating native riparian vegetation. Settlers and miners cleared the larger timber from the valleys and low-lying hills. Ranchers and miners continued to burn the landscape, but often indiscriminately. New species of plants and animals were introduced with ranching and farming, displacing or replacing native species. Unregulated hunting depleted the game and almost eliminated predators.

These effects are partially revealed in the notes taken by government surveyors on the alternate sections of lands granted to the O&C railroad. The lands were returned to the government in the early part of the twentieth century. By 1916-18, these notes showed timber did not exist in the eastern sections along the Applegate River, only small amounts of pine and fir in the lower hills. Brush was prevalent on the south-facing slopes of Star Gulch, with some good quality pine and fir on the north-facing slopes and along Star Gulch itself. Both fires and clearing depleted the timber that once existed in the foothills and valley and at mid-elevations on south-facing slopes in Star Gulch.

Early Twentieth Century Conditions 1900-1940

Ranching, farming, and mining continued as major activities in the analysis area. Mining was less prevalent than in the previous century, but remained part of the local way of life. By 1919, the Cameron Ditch along lower Star Gulch was in operation. It was used for placer operations during the winter months of November to May (Jackson County Circuit Court 1919), and quartz (lode) mining increased in the area (Swenning 1909). Local ranchers grazed stock throughout the analysis area. A 1923 Forest Service grazing atlas showed salt logs scattered throughout the area (Holst 1923). Settlement continued to show more development, with the building of houses along the Applegate River and cabins up Star Gulch (Harrison 1909), though local farms and ranches stayed primarily in the same families (Black and Black 1990).

Local people continued to expand their communication networks. A wagon road extended up Star Gulch to cabins in Sections 13 and 19 by 1909 (Harrison 1909). By 1917, a bridge was constructed over the Applegate River, just south of Star Gulch (Black and Black 1990). By 1923, a lookout was established on Tallowbox Mountain, with a trail and phone line. By the 1930s, the Civilian Conservation Corps built a road up to the Tallowbox Lookout. In 1923, a trail and phone line went up the ridge to Palmer Peak from Star Ranger Station, and a trail and house went up in Boaz Gulch (Holst 1923). By 1930, there were trails in Star Gulch, Lightning Gulch to Palmer Peak, and in 1918 Gulch to Mt. Baldy (USDA 1930).

A major new influence in the analysis area was the advent of the Forest Service. Star Ranger Station was built in 1911 to house the new rangers who were responsible for the area's federal land, including the land in the Applegate-Star/Boaz Watershed Analysis Area. They spent much of the early decades of this century fighting both fires and the local propensity to start them. The federal emphasis on fire suppression derived from the heavy use of fire by locals, prompting the following comments by officials from the local district in 1916.

"The timber in this district is scattered. It grows only in clumps and isolated watersheds, particularly on north slopes where it has escaped the ravages of forest fires. Practically all the district has been burned over from time to time during the past 100 years, and many areas are entirely denuded except for manzanita, chaparral, and chemise brush, which always comes after burns." (Brown 1960)

". . . incendiarism plays the largest part . . . the principal reasons . . . are the beliefs that burning the brush areas will provide better hunting and better range and furnish employment [as fire-fighters] to local people . . ." (Brown 1960)

One response to fire was to establish lookouts, such as the one at Tallowbox Mountain in 1923 (Brown 1960). In the 1930s, a spike camp for crew members of the Civilian Conservation Corps (CCCs) was located at Star Ranger station. The CCCs crew worked on fire suppression and improved the roads and trails up Star Gulch (Brown 1969).

The effects of human action continued to manifest on the landscape. Anecdotal descriptions of forest vegetation reflect a region denuded of its large trees in the hills and valleys, and affected by uncontrolled fires at mid-elevations. At the same time, new growth, especially Douglas-fir, appears on the landscape. This is especially notable in areas formerly controlled by native burning. A 1911 homestead claim near the mouth of Star Gulch, for example, notes that the Douglas-fir on the parcel is about 60 years old, corresponding to the demise of native Indian burning practices. Elsewhere, a 1913 Forest Service report notes hunters want to burn brush, but "young timber in many places is coming up through the dense brush" (Brown 1960).

Water resources continued to be used for mining and also for irrigation, with effects on the habitat for anadromous fisheries. A homestead claim of 1911 notes that "There is no water for irrigation, being already appropriated for irrigation and mining purposes. Plenty of water for domestic use may be obtained from the creek [Star]." Ditches were rarely screened, and fish frequently perished in the irrigation and mining systems.

There was still a bounty on wolves in 1917 in an effort to eliminate predators (Brown 1960). During the next few decades, Forest Service records note the increasing problem of coyotes. Game hunting remained good during this period and many people hunted.

The timber industry remained small-scale in the analysis area during this period. Low demand, transportation problems, lack of first rate timber, and fragmented holdings of federal lands all operated to inhibit the industry until the 1940s and the war boom (USDA 1921; Brown 1969).

Later Twentieth Century Conditions

Landscape changes in the latter half of this century resulted in large part from those policies guiding BLM practices. Alternate sections originally designated for O&C railroad development were reverted to the U.S. Department of the Interior prior to World War II. In the Applegate-Star/Boaz Watershed Analysis Area, this action resulted in the BLM and the Forest Service managing alternate sections of land. In 1956, a land exchange consolidated holdings for the two agencies and BLM became the primary land manager in the analysis area.

Beginning in the mid-1950s, the Lower Big Applegate Association obtained a lease to graze 29,736 acres of BLM-managed lands. This area conforms somewhat to the lands contained within the Applegate Allotment #20201 and the Lower Big Applegate Allotment #20206 (Map 15). The Applegate-Star/Boaz Watershed Analysis Area is almost completely contained within these two allotments.

The Lower Big Applegate Association was composed of seven members who grazed their cattle from April 1 through June 30. A total of 421 cattle were grazed by the association in 1955. Due to a land exchange with the Forest Service, the association's grazing area increased to approximately 40,000 acres. The greatest number of livestock grazed was 506 cows in 1957. Livestock numbers decreased to approximately 310 cattle during the 1960s and to 206 cattle in 1971. In 1975, the BLM discontinued the Association's lease and began issuing permits to individual operators. Prior to 1981, the Applegate Allotment #20201 and the Lower Big Applegate Allotment #20206 were a single allotment in excess of 37,000 acres. The allotment was split at the request of the operators.

During the late 1940s to 1950s, small rural sawmills and small logging outfits supplemented the huge production of the large wood-products plants situated in the Medford/Central Point/White City area. A mill in the town of Ruch operated during the boom years, but closed during the 1960s (LaLande 1995).

Large scale intensive forest management practices began on BLM-managed lands in the early 1960s. These practices included the inventory of commercial coniferous forests and an annual timber sale plan in the Jackson Master Unit. Annual harvest level for the Applegate Forest Management Area were approximately 78 million board feet (mmbf) during the 1960s and continued to increase the following decades. Timber sales included road construction and a tree planting program (USDI 1975).

The common logging systems on BLM-managed lands in the 1960s included tractor harvest on gentle to moderate slopes and high lead cable systems on steep slopes. During the mid-1970s, skyline cable logging systems began to replace high lead cable logging systems and tractor logging was limited to gentle slopes. During the 1980s, soil compaction concerns led to summer logging and the use of designated skid roads and one-end suspension (skyline) cable yarding systems. During the 1980s and 1990s, helicopters were used for salvage logging in harvest areas that had few roads and low harvest volumes per acre (USDI 1995).

Table 17 summarizes silvicultural treatments on the lands harvested during the intensive forest

management period within the analysis area.

Table 17. Acres Harvested on BLM-Administered Lands

Year of Sale	Clear-cut	Select-cut	Salvage	Shelter-wood	Overstory Removal	Thinning
1950s	71	31	0	0	0	0
1960s	614	636	494	0	36	0
1970s	10	1,261	285	43	97	17
1980s	1,184	1	56	41	478	0
1990s	8	1	5,059	0	51	0
Total	1,887	1,930	5,894	84	662	17

In 1972, the State of Oregon legislated the Forest Practices Act, which addressed all forest operations including road construction and maintenance, timber harvesting practices, chemical use, slash disposal, and reforestation requirements (Pacific Logging Congress 1981). The act was amended in 1993 to provide additional protection for water quality and riparian vegetation.

For the majority of the federal lands in the analysis area, management focused on fire suppression. By the late twentieth century, the effects of long-term fire suppression were becoming apparent in the analysis area, as elsewhere in the region. Logging, mining, and grazing remained the dominant uses.

ROADS

As Europeans moved into the area, a transportation system began to develop. In the 1870s, trails and wagon roads provided transportation routes for early settlers and miners. In the early 1900s, access roads were improved and others constructed for private access, fire prevention, and other land management activities. Historically, the BLM emphasized timber management, and a transportation system was developed and maintained with timber sale revenues. The majority of BLM roads were constructed during the 1960s as haul roads for timber.

EROSION PROCESSES

The historical erosion processes were generally the same as those described in the Current Conditions section. Surface colluvial movement (ravel) was dependent on rates of geologic uplift. It occurred on very steep slopes usually associated with rock outcrops on ridge shoulders, sideslopes, and protruding benches (Pullen 1996). Native people probably did not accelerate the rate of erosion by their burning practices because they did not burn on very

steep slopes.

Concentrated flow (gully and rill) erosion occurred mainly in draws where channels were created. The density of these channels varied with climatic cycles. During wetter cycles, the intermittent stream channels were more common. During dry cycles, cobbles, gravel, and plant debris would accumulate in the draws and bury channels, allowing subsurface flows. It is doubtful that the native people burned these areas because the moist draws provided wildlife habitat (water and cover). Consequently, the effects from native and natural fire regime on this process was probably minimal.

The existence of residual granite soil in the lower Boaz Gulch area indicates that mass movement or landslides probably did occur in the Boaz area hundreds to thousands of years ago. The source of this alluvial material is not currently evident, although there appears to be some mixing of metamorphic and granitic substrata in the steep to very steep upper slopes. Landslides were probably common in areas of contact between granitic and metamorphic rocks.

SOIL PRODUCTIVITY

Organic matter levels, a measure of soil productivity, varied with climatic cycles and management intensity. During wet cycles, organic matter would accumulate, thus increasing productivity. During hot, dry cycles, organic matter would be depleted or have minimal accumulation. Soil productivity was probably very similar to that shown on Map 8. Natural disturbances in the form of wildfires and wind damage created areas of plant regeneration that were probably less than ten acres in size. The disturbance contributed to coarse woody material in forested areas.

Native people burned brushlands and meadows in the lower and the gentle to moderate upper slopes. Burning may have slightly reduced soil productivity in the ponderosa pine stands, though it would have enhanced the pine habitat and increased grass/forb occupation of sites. The slight reduction in soil productivity was due to fire consumption of organic matter. The resultant fuel reduction decreased fire hazard and diminished the risk of larger losses in soil productivity by wildland fire. Thus intense burning of the surface mineral soil was minimal (see Soil Productivity, Current Conditions).

VEGETATION DENSITY AND VIGOR

The vegetation endemic to the analysis area is a result of time and the unique geology of the area. The Siskiyou Mountains of the Klamath Geologic Province serve as a link between the Cascade Mountains and the Oregon and California coast ranges. Over the last 60 million years, vegetation has migrated into this area from six different directions: the Oregon and California coast ranges (red alder, Pacific madrone, and bigleaf maple), the Sierras and Cascades (baneberry, Shasta red fir, sugar pine, manzanita spp., and California black oak),

and the Klamath River corridor and lowland chaparral area (juniper and mountain mahogany) (Atzet 1994).

Historically, the vegetation of the Applegate-Star/Boaz Watershed Analysis Area differed from the current conditions that exist today. Early surveyors found "lower slopes that were largely bare of trees or that contained scattered mature pine timber, a complex mosaic at mid-to-upper elevations that consisted of mature/old-growth pine and fir stands, remnant oak and cedar openings, brushfields and numerous patches of young reproduction; at the highest elevations, a more grass-dominated mosaic that supported true fir—most of it, while perhaps not 'young,' smaller in size than the mature timber on the mid slopes." (USDA 1995a). Annual tree growth was probably greater because of the open nature of the stands.

Differences in species composition and stand structure have been noted historically. The General Land Office (GLO) data recorded during the mid-1800s for T.39S. R.3W., which includes about half of the analysis area, shows the five most common species to be: black oak (41.7 percent), white oak (22.2 percent), ponderosa pine (17.4 percent), madrone (8.3 percent), and Douglas-fir (5.3 percent) (McKinley and Frank 1996).

An analysis of the GLO notes and homestead data for the area adds detail to the above picture. Black oak, a resource favored by native people, was predominate in the valleys and lower hills. An 1857 surveyor notes "open pine and oak timber, the south slopes covered with grass" for the lower elevations. In the higher elevations an 1884 surveyor notes a "thick undergrowth of fir, . . . , pine, oak, hazel, and matherone [madrone], and some dense forests of fir, yellow and sugar pine, oak, and timber of good quality." A more detailed look at these notes shows that open pine and oak occurred mainly in the lower elevation hills and valleys in the eastern part of the analysis area. Dense fir forests occupied north-facing slopes at higher elevations, with oak, madrone, and brush on south-facing slopes and at higher elevations. Larger trees occurred in the more open spaces at lower elevations, in the valleys, hills, and riparian areas. Little or no Douglas-fir existed at lower elevations (McKinley and Frank 1996). The ridges above Star Gulch were covered in brush.

In the 19th century, many of the forest stands consisted of large diameter trees, mostly pine, in a more open type of forest, predominantly multilayered rather than single layered. The current even-age, single canopy stands are a result of stand replacing fires of the 1800s and the impacts of intensive forestry practices. Fire suppression, since these stands originated, has kept them intact. Only occasional residual trees with old-growth characteristics remain in these even-aged stands, which have spread across the landscape.

Historically, there was more vegetation in the late seral stage of development than there is today. Seral stage information taken from 1947 GLO data for the Applegate area shows that in 1947, vegetation was 30.5 percent in early seral stage, 21.3 percent in mid-seral stage, and 48.2 percent late seral stage. This differs from the 1994 BLM Geographic Information System (GIS) data, which shows 35.1 percent in early seral stage, 49.8 percent in mid-seral stage, and 15.1 percent in late seral stage (McKinley and Frank 1996). Early seral stage refers to the earliest period following a disturbance characterized by grasses, forbs, brush, young hardwoods, and conifer seedlings. Mid-seral stage refers to the stage of development where

the canopy begins to close, density leads to mortality and a decrease in ground cover. Later seral stage refers to the stage in development where mortality and snag formation lead to a more diverse and mature forest structure, with a developing understory (McKinley and Frank 1996). (Note: the seral stages referred to in this document should not be confused with BLM vegetation condition classes.)

Historically, fire was a primary force in shaping the landscape into a mosaic of vegetation communities and age classes. The fire return interval is estimated to have been 2 to 30 years between fires. Prior to European settlement, Native Americans probably burned annually. This frequent burning tended to maintain a more open type of forest that supported large diameter trees and favored the establishment of pine species (see Human Uses, Native Reference Ecosystem). Windstorms were responsible for creating openings similar to stand replacement fires. With a fairly frequent pattern of occurrence, these disturbances helped add to the coarse-grain pattern of the landscape.

Euro-American settlers cleared the lower elevation land for homesteads and agriculture and used the timber for construction. Although these settlers did use fire to maintain grasslands for grazing, the trend toward fire suppression began with the advent of the Forest Service in the early twentieth century. Fire suppression changed the landscape drastically as open, large-diameter pine forests were converted to dense Douglas-fir and white fir stands. With the increased density of the forest came elevated fuel loading and the threat of intense wildfire. Bark beetle populations increased and caused mortality in both old-growth and second growth trees. Some stand replacing fires occurred in the twentieth century.

PLANT SPECIES AND HABITATS

Special Status Plant Species and Habitats

The historic relative abundance and distribution of special status plants in the analysis area were probably greater when natural processes were allowed to function uninhibited. Natural disturbance and succession are two processes that, along with competition, shape vegetation occurrences. Many species are fire dependent and could have become totally excluded from the area with the advent of twentieth century fire management. Populations of the *Cypripedium* species, which prefer late-successional/old-growth forests with closed canopies, have declined. Species that occur along the riparian areas were probably more plentiful prior to the advent of mining and road building. This would be due not only to the loss of habitat, but also to the introduction of non-native vegetation.

Botanical inventories and records were not kept before 1977, and the Applegate-Star/Boaz Watershed Analysis Area was altered prior to this period (for example: by gold mining, timber harvesting, domestic livestock grazing, and farming). For this reason, there is currently no way to accurately document what the reference conditions of the analysis area were prior to 1977.

Survey and Manage Plant Species and Habitats

Inadequate information exists on most of the non-vascular Survey and Manage species. Decreases and fragmentation of the forest have caused a serious threat to bryophytes that grow on decaying wood in other areas (Laaka 1992). Logging related factors that cause declines in bryophytes and lichens include: the temperature extremes and the drying effect of increased wind, the lowering of surface water, the drying of logs, reduction in amount of coarse woody material substrate, and increased dispersal distance between fragments of forest (Laaka 1992). Habitat conditions for these non-vascular species, if they occur in the analysis area, have probably declined. Reference conditions for the Special Status Plant Species apply to the vascular survey and manage species.

Noxious Weeds

Yellow starthistle is native to the Mediterranean region of Europe and North Africa (Larson et al. 1994). It was detected in California in the early 1800s and probably began spreading throughout the Northwest in the 1920s (Larson et al. 1994). Bull thistle is also native to Europe and has been present in Oregon for some time (French and Burrill 1989).

FIRE

The historical fire regime of this analysis area is characterized by frequent (1-25 years) and widespread fires resulting from the hot, dry summers. Accounts documented by early settlers of Oregon indicate that wildfires were common, widespread, and produced substantial amounts of smoke impacting visibility and the health of local residents (Morris 1934). These periodic fires consumed understory and ground fuels thus leaving a large gap between the overstory and ground. This in turn reduced the probability of a crown fire. Typically, fire intensity is low because frequent fires limit the time for fuel accumulation. Consequently, the effects of individual fires on flora, fuels, and fauna were minor, creating a more stable ecosystem.

Fires maintained most valley bottomlands and foothills as grasslands or open savannas. Forests created from frequent, low intensity fires have been described as open and parklike, uneven-aged stands characterized by a mosaic of even-aged groups in the lower elevations. Ponderosa pine, Douglas-fir, sugar pine, and white fir were the most common species. All four of these species are resistant to fire as mature trees; but as saplings, ponderosa pine is the most resistant followed by sugar pine, Douglas-fir, and white fir. Frequent fires had major structural effects on young trees favoring ponderosa pine as a dominant species and white fir as the least dominant in this forest type. Without fire, Douglas-fir and white fir became the dominant species because they are more tolerant of understory competition than the pine species.

TERRESTRIAL WILDLIFE SPECIES AND HABITATS

Wildlife - General

It is difficult to precisely discern habitat conditions and relative abundance of wildlife in the analysis area at the beginning of the historic period (early/mid-1800s). The reference conditions for human processes influencing the Applegate-Star/Boaz Watershed Analysis Area provide insight to what general habitat conditions might have been.

Native Americans influenced wildlife habitat conditions on the valley floor and valley slope portions of the analysis area by burning. These areas were routinely burned by the natives to maintain conditions suitable for the plants and animals they relied on for subsistence, such as tarweed, deer, and elk. The controlled burning maintained an early seral condition (grasses and low shrubs), in conjunction with scattered large ponderosa pine and white and black oak. This type of management practice likely resulted in relatively large populations of deer and other wildlife species preferring these early seral conditions.

The mid-elevation conifer forest was not managed by Native Americans, and was subject only to natural phenomena, such as natural fire, which was less frequent than Native American burning. This area was characterized by large Douglas-fir and ponderosa pine with a shrubby understory and an abundant supply of snags and down woody material on north and east-facing slopes (Pullen 1996). South and west-facing slopes were dominated by chaparral with scattered ponderosa pine and hardwoods. Wildlife species preferring mature/old-growth conifer stands and chaparral were probably quite populous in this zone. Pullen (1996) indicated that diversity was the dominant theme of the Applegate River Subbasin in the prehistoric period. This diversity was presumably conducive to healthy populations of a variety of wildlife species.

Vegetation mapping from 1947 provides some indication of the relative abundance of the various habitat types in the early/mid-1800s. Although there obviously was habitat change from the 1800s to 1947, it appears the upland forested areas remained largely intact. Primary habitat change during this period was likely due to: the clearing of riparian vegetation to facilitate mining operations, clearing of the scattered oaks and pines on the valley floor to facilitate agricultural pursuits, and fire suppression in the rest of the analysis area. Relative abundance of plant communities and condition classes based on the 1947 mapping are presented in Table 18.

Table 18. Reference Condition Habitat Acres

Habitat/Condition Class	Reference Condition Acres (%)
Grass, forbs, herbaceous vegetation	1,895 (11)
Shrubs, hardwood/woodland	4,640 (26)
Early seral	1,838 (11)

Habitat/Condition Class	Reference Condition Acres (%)
Poles (5-11" dbh)	965 (5)
Mid-seral (11-21" dbh)	2,784 (16)
Mature/old-growth	5,528 (31)

Given the reference habitat conditions, species currently present in the analysis area were likely present in the early/mid-1800s, with the exception of some introduced species (starling and Virginia opossum). Also, some species that were present then have now been extirpated, such as the gray wolf and grizzly bear.

Threatened/Endangered Species

Both threatened species found in the analysis area (northern spotted owl and bald eagle) are presumed to have been present in the early/mid-1800s. Although spotted owl and bald eagle presence could not be confirmed, habitat conditions at that time indicate these species were present (LaLande 1995; McKinley and Frank 1996; Pullen 1996).

Due to the abundance of mature/old-growth habitat, spotted owl populations were probably higher (Table 18). Also, the presence of excellent riparian habitat along the Applegate River and an abundant supply of fish in the Applegate River would indicate that bald eagles likely used the analysis area for foraging during the winter months.

Northern Spotted Owl Critical Habitat

Reference conditions for northern spotted owl critical habitat will be addressed on the basis for its designation in 1992 since critical habitat did not exist in the early/mid-1800s. Critical habitat is designated under the auspices of the Endangered Species Act of 1973.

The two critical habitat units (CHUs) in the analysis area are OR-74 and OR-75. Both CHUs were established to provide for nesting, roosting, and foraging habitat in an area of high habitat fragmentation (USDI (FWS) 1995). Additionally, blocks of contiguous habitat and known owl sites were incorporated in OR-75. Together, these CHUs provide east-west connectivity across the southern portion of the Klamath Mountains Province and link other CHUs in this area.

Survey and Manage Species and Protection Buffer Species

Based on the habitat presumed to be present in the analysis area in the early/mid-1800s, it can be assumed that at least two Survey and Manage species, Siskiyou Mountains salamander and red tree vole, were present when Euro-Americans arrived. Given that both species appear to be associated with mature/old-growth conifer forests, populations of these species were likely quite robust since this habitat was relatively abundant (Table 18). Siskiyou Mountains salamander is also a talus obligate and talus appears to be quite plentiful in the analysis area.

The great gray owl, a protection buffer species, appears to be a relative newcomer to the valleys of southwest Oregon via a systematic range extension. It probably was not present in the analysis area at the time of Euro-American settlement; however, this could not be verified.

Due to a dearth of basic inventory and life history information for the five Survey and Manage molluscs that might be present in the analysis area, little can be inferred about their presence or abundance at the time of Euro-American settlement.

Special Status Species

As with the Survey and Manage species, all 21 special status species were likely present at that time (Table 12). Most of the primary threats associated with their present status were generally of no consequence prior to Euro-American presence. Without these threats, populations of the various species were probably greater and more stable.

HYDROLOGY

Historically, streamflows experienced high and low extremes similar to current conditions. The exception is the Applegate River below the dam, where the extreme streamflows have been moderated since the dam was completed in 1980.

Historic floods occurred in 1853, 1861, 1890, 1927, 1948, 1955, 1964, 1974 (LaLande 1995), and 1997. The 1964, 1974, and 1997 floods are the only historic flood events recorded at the Applegate River gaging station near Copper. It is estimated that the 1974 flood was greater than a 100-year flow event, and the 1964 flood approached a 100-year event (USDA 1995a). These flood events resulted from rain-on-snow events.

Water withdrawals for mining and irrigation in the late 1800s and early 1900s greatly reduced summer streamflows in the analysis area. Historic low flows in the Applegate-Star/Boaz Watershed Analysis Area were associated with years of low precipitation. Drought conditions were noted in 1841, 1864, 1869-1874, 1882-1885, 1889, 1892, 1902, 1905, 1910, 1914-1917, 1928-1935, 1946-1947, 1949, 1959, 1967-1968, 1985-1988, 1990-1992, and 1994 (LaLande 1995; NOAA 1996). It is likely that many of the smaller streams went dry during the drought years and low flows in the Applegate River prior to the dam provided minimal aquatic habitat.

STREAM CHANNEL

Historically, the steep, headwater streams in the Applegate-Star/Boaz Watershed Analysis Area had adequate amounts of large woody material to create a step/pool profile. The lower reach of Star Gulch had more aquatic habitat prior to being hydraulically mined in the 1870s. It probably had a lower width/depth ratio, an ample amount of large woody material, and easily accessed its floodplain without any constricting berm or road adjacent to the channel. Prior to European influences, the section of the Applegate River flowing through the watershed

analysis area likely had a lower width/depth ratio, possibly multiple channels during low flows, greater sinuosity, and could access its floodplain during flows greater than bankfull.

Less sediment was available to the stream system prior to mining and road construction activities. Less sediment was transported out of the stream system and deposition was greater than today because large woody material was more prevalent historically. The large wood was capable of trapping and storing more sediment.

Beavers were abundant in the Applegate Valley prior to the advent of fur-trappers around 1830. Beaver dams added woody material to streams, trapped and stored fine sediments, and reduced water velocities. The loss of beaver dams likely resulted in scouring of channel beds and banks, increased width/depth ratios, and fine sediment deposition in pools.

Hydraulic mining in the mid- to late 1800s had a dramatic effect on stream channels, especially the lower reaches of Star Gulch. Channels became more entrenched and width/depth ratios increased. Sinuosity was lowered as stream gradients increased. Increased sediment loads filled pools with fine sediment.

Roads were constructed adjacent to the Applegate River and Star Gulch during the late 1800s and early 1900s. These actions confined the channels, which restricted the natural tendency of streams to move laterally. The low gradient, Applegate River became entrenched and was not able to access the adjacent floodplain except during major peak flow events. Channel width/depth ratios increased and sinuosity was lowered as stream gradients increased. Maximum stream velocity decreased along with a decrease in bedload transport capability, which lead to increased sediment deposition.

Logging and land clearing for agricultural use resulted in the removal of large woody material from stream channels in addition to removal of stream-adjacent trees. This depleted the existing large wood and future large wood recruitment sources. Floods became more destructive without sufficient instream structure to slow the high stream energy. As more streambank erosion occurred, the channels widened, and as the streams downcut, the channels became entrenched.

WATER QUALITY

Overall, historic summer water temperatures were likely lower than today due to lower width/depth ratios and more riparian vegetation. Given the fire occurrence prior to 1920, some stream reaches could have been sparsely vegetated for periods of time, resulting in higher water temperatures. During low flow years, the hot summer air temperatures could have produced stream temperatures similar to today's under the same climatic conditions.

Ranching, farming, and mining in the late 1800s and early 1900s and logging in the mid-1900s resulted in a reduction in riparian vegetation, allowing more solar radiation to reach the streams. Increased water temperatures were likely a result of this activity. Removal of

riparian vegetation also resulted in less large wood in the stream channels, which created greater width to depth ratios. Wide shallow streams tend to have higher stream temperatures. Irrigation and mining withdrawals lowered streamflows and contributed to increased stream temperatures.

Sediment loads and turbidity levels were probably lower due to fewer sediment sources prior to European influences. Sedimentation and turbidity rose dramatically in conjunction with hydraulic mining. Land clearing and road building by settlers also provided a source of sediment to streams.

RIPARIAN AREAS

Before Euro-Americans

Before the influence of western civilization, the Applegate River valley was much different than it is today. The irrigated low-lying farmland along the river was a thicket of willow with winding side channels and beaver ponds. Beaver were so prevalent, that the Takelma people called the Applegate "the beaver place." In these beaver areas, aquatic and terrestrial vegetation was diverse, providing habitat for a wide variety of riparian-dependent species. The lower slopes above these floodplains were thick with grass and covered with open oak and ponderosa woodlands (Pullen 1996).

The riparian areas in Star Gulch were probably heavily timbered with a mix of conifers, maples, ash and some alder, much as it is today (Pullen 1996). The primary difference in vegetation is the size of the trees. Before the influx of settlers, standing trees were primarily removed naturally by fires, winds, floods, insects, and diseases. Both conifers and hardwoods were probably of larger diameter, and undoubtedly, downed woody material was also large. Downed logs would have been common, especially in the north-facing streams.

North-facing tributaries to Star Gulch would have been heavily timbered, with an understory adapted to a cool, damp climate. The cool, moist influence of the riparian area would have extended far up the slopes, so maples and similar plant species would have extended beyond the bottom of the stream channel.

South-facing tributaries would have been thick with brush, with dense riparian vegetation occupying only the bottom area of the stream channel. Big downed logs, may have been less frequent than in the north-facing tributaries. Beaver ponds may have been present near the mouths of some of the tributaries, forming tiny wet meadows up the edge of the stream for about the first one-quarter to one-half mile.

Lime Gulch and other intermittent frontal streams were similar to Star Gulch and its tributaries. West-facing intermittent streams were thicker with brush, sparsely occupied by big conifers with some maple and ash mixed with madrone and oak. Willow and hazel thickets would have covered the mouths of the streams. The streams would have meandered through the oak woodlands and disappeared in beaver ponds or side channels on the mainstream of the

Applegate River.

After Euro-Americans

The discovery of gold in the Applegate River brought miners to Star Gulch in the 1850s. As mentioned in the Human Uses section, Star Gulch was "mined out" by 1911, only 60 years later. As streams flooded, they deposited gravels along their floodplains. The miners prospected the bank gravels as well as the gravels in the streambed. They logged or burned riparian areas to access the floodplain gravels, undoubtedly severely impacting the riparian area. The lack of riparian vegetation in the channel may have also increased channel erosion and downcutting from big floods in the 1880s and 1920s.

Because Star Gulch has a narrow valley, settlers built trails and roads through riparian areas. In the 1930s, the Civilian Conservation Corps (CCC) used bulldozers to build a road up Star Gulch to the Tallowbox Lookout. Upstream of Alexander Gulch, the CCCs constructed a road adjacent to Star Gulch, reducing the riparian area to a thin strip on one side of the creek.

By 1916-1918, both fires and clearing had depleted the timber that existed in the foothills and valley and at mid-elevations on south-facing slopes in Star Gulch. The activity probably increased the amount of erosion in small intermittent streams, especially on south slopes. Increased erosion may have lead to downcutting and narrowing floodplains and riparian areas.

Recent Decades

Portions of the Star Gulch drainage were clearcut in the late 1970s and early 1980s. Regulations at the time did not adequately protect streams and riparian areas. Timber on the north-facing slopes (the trees that protected the riparian area from summer sunlight and heat) was removed in several areas, destroying the cool, humid nature of the riparian area. In addition, many roads were constructed in the riparian area, leaving only a narrow strip of trees between the road and stream. In some areas, harvest extended almost to the edge of the stream channel. The best growing conditions in the Star Gulch drainage are along stream channels. Roads adjacent to or crossing stream channels further reduced riparian habitat.

AQUATIC WILDLIFE SPECIES AND HABITATS

Native people in the Applegate Valley relied heavily upon salmon, steelhead, lamprey, and suckers, drying the fish and storing it for winter. Oiler salmon was better for storing over longer periods of time and therefore, salmon was preferred over steelhead.

The Applegate stream system had a very large amount of fish. The beaver marshes and side channels would have provided rearing areas for coho salmon and other juvenile fish, as well as winter habitat. Floods would have spread out over floodplains full of willow thickets, cottonwood groves, and beaver marshes. Flood flows would not have caused mainstem channel downcutting and habitat simplification. Woody debris jams along river banks would have created pools and provided cover and excellent habitat for adult fishes. Spawning habitat

was plentiful. If floods destroyed redds, enough fish survived that the population quickly rebuilt.

The mouth of Star Gulch was perhaps not as perched above the Applegate River as it is now. The mouth would have been rocky, but there would not have been such a precipitous drop down to the river. Fish would have easily navigated the cascade. The river bed elevation may have dropped through the years, as river confinement and placer mining accentuated channel downcutting during flood events. The Applegate River would have had rich gravel and cobble deposits due to the amount of source material in the headwaters.

As mentioned in the Riparian section, Star Gulch was heavily mined from the 1850s to the early 1900s. Miners probably logged and cleared the riparian area, as well as worked the gravels and cobbles for gold. As miners worked through a section of stream or bank, they dumped the rocks in big piles alongside the stream, further channelizing and confining it. The combination of channel narrowing with lack of large wood would have exacerbated channel downcutting, dramatically reduced the number and quality of pools, destroyed overwintering areas where fish could withstand high flows, reduced the stream's ability to retain gravels and cobbles, and eliminated spawning areas. Most of the mining occurred during the spring and early summer, coinciding with steelhead spawning and early rearing, two life stages where the fish are particularly susceptible to disturbance.

By the turn of the century, a complex irrigation system was in place and ditches were rarely screened. Past records indicate that thousands of steelhead fry perished each year in irrigation ditches.

Road construction in the 1930s included three or four stream crossings with small narrow culverts. Forty years later, these culverts were still impeding fish passage. In the late 1970s, these culverts were replaced, although they may not be capable of withstanding 100-year return interval flood events.

BLM records note that steelhead could not get up into Star Gulch in 1972 and 1973. In 1974, Rogue Flyfishers built a cement fish ladder at the mouth. BLM also blasted jump pools in bedrock chutes near Benson Gulch to improve fish passage. The prevalence of bedrock chutes and channel narrowing is probably a legacy from gold mining and road building.

SYNTHESIS AND INTERPRETATION

The purpose of the Synthesis and Interpretation section is to compare current and reference conditions of specific ecosystem elements and to explain significant differences, similarities, or trends and their causes.

HUMAN USES

History

Human activities have affected the local landscape for thousands of years. Native people were sustained by the use and management of natural resources for food, tools, shelter, and trade. With the immigration of Euro-Americans to the area, different philosophies, values, and ideas associated with world economics changed the native landscape. Throughout the long history of the analysis area, two major and contrasting ways of human life have affected the local landscape (Table 19).

Table 19. Human Components of the Ecosystem

Native Reference Ecosystem: (<1800)	
Population	< 200
Economy	Local subsistence, based on natural resources, enhanced and managed for local use and consumption and for some external (regional) trade.
Settlement pattern	Permanent riverside villages; seasonal, temporary use of foothills, ridges; trails up major waterways.
Technology (tools and knowledge)	Land management based on indigenous knowledge (local, specific, experiential), simple hand tools, fire.
World view, beliefs, goals	Goals: resource enhancement; sustainable subsistence. Small-scale, traditional society, linked through kinship and bonds of mutual obligation, and closely integrated with the natural world within which they lived; beliefs reinforced the interdependence of the natural and human world through the metaphor of kinship with species and natural forces.
Historic/Current Conditions	
Population	< 500 Daytime population increases with transient work force (FS, BLM, other).
Economy	Linked to global market economy, responsive to complex factors beyond local control.

Historic/Current Conditions	
Settlement pattern	Dispersed residences along the river corridor. Government facility at location of native village. Main transportation corridor along river; access to hills and uplands increasing through time; area currently well-roaded and most parts of the analysis area accessible by road. Considerable transient and non-resident use of the analysis area by government employees, contractors, etc.
Tools and technology	Scientific knowledge (theoretical, generalizing, experimental). Initially pre-industrial tools and technology based on metal, mechanics, animal and human power. Industrial and post-industrial tools and technology.
World view, goals	Early goals: extraction of natural wealth, transformation of native landscape to productive agricultural lands; economic and personal independence for residents. Later goals: multiple and sometimes conflicting; include profit motivated economic goals and commodity production; resource conservation and preservation; biodiversity; community building; personal independence and "quality of life" issues. Large-scale, complex, industrial society based on multiple beliefs; initial resource extraction views shift later to commodity production, which conflict with early conservation and preservation movements; today, these conflicting perspectives are attempting to find common ground in the perspective of ecosystem management.

Prior to the nineteenth century, the native Indian people lived in villages along the Applegate River and its tributaries. They obtained the materials needed for daily life from the river, valley, hills, uplands, and through trade with their neighbors. Within the analysis area, populations probably remained below 100 to 200 people. Residence was at a village near the mouth of Star Gulch and perhaps at other locations along the river. Paths and trails led up Star Gulch and probably other drainages, accessing the resources of the foothills and higher elevations.

Those who lived in the analysis area managed the land to enhance resources that were of value, such as root crops, seeds, nuts, game, and materials for baskets and bows. Most of these resources were meant for local consumption, though some, such as the black or white oak acorns, may have been used in trade. Native land management fostered a landscape with a diversity of plants and animals and an abundance of staple crops.

Native people used a number of techniques to achieve their goals. Selective use of fire was important, especially in the valleys and foothills of the analysis area. Native fire management worked within natural constraints, emphasizing fire on south-facing slopes and burning when weather was conducive to cool, low intensity burns. Selective harvesting of game, fish, and crops ensured the propagation of species for the future.

By the middle of the nineteenth century, another cultural regime was making itself felt in the analysis area. Western civilization, brought first to the area by trappers and explorers, changed the nature and intent of human interaction with the natural environment.

The initial period of non-native occupation of the analysis area was characterized by transient

populations intent on extracting the region's fur and mineral wealth. These visitors were tied to global market economies, and their advent to the area abruptly and permanently changed the nature of local economic activity. From the middle of the nineteenth century forward, human interactions with the landscape have been substantially motivated by economic concerns generated by external links to the region, nation, and world. The fur markets in China and England drove the initial penetration of the region, as did the demand for gold on a world market. Later, ranching, agriculture, and logging enterprises rose and fell with the fate of outside markets.

In the early decades of this century, much of the analysis area was managed by the Forest Service and later, BLM. As a result, land management policies in the analysis area reflect national political decisions, as well as external market factors.

The history of human interactions within the analysis area has been one of gradually increasing impact upon the land. This occurred primarily after the advent of powerful technologies and increased access to distant markets. When native people lived in the area, valleys and lower elevation foothills were more intensively managed through fire than were the riparian and mid-elevation areas. Early trappers, miners, and settlers largely concentrated their efforts on riparian and valley lands, permanently affecting the distribution of native flora and local hydrologic regimes. Cattle grazed throughout the analysis area as ranching expanded in the later nineteenth century. Fires that affected the landscape were set purposely. In the twentieth century, fire suppression and the development of the timber industry and silvicultural practices have extended significant human influence to the entire analysis area. Human actions have affected and continue to affect major elements and processes within the analysis area. Scientific practices incorporated into ecosystem management currently have the potential for affecting virtually all aspects of the local ecology.

In the late twentieth century, there is a growing realization that both the biological health of the land and sustainable economic practices require land managers to take greater account of specific local conditions and local community knowledge. The need for more community involvement and more flexibility to define local landscape practices has led to a different management approach. This has resulted in the federal government's current focus on ecosystem management and the implementation of adaptive management practices.

Similarities between Native/Historic

There are few similarities between the native and the current conditions with regard to the human dimension. Human resident populations are low today as in the past, though the connections of those who live in the analysis area with the outside world are so fundamentally altered that human use and interactions within the analysis area are very different. There is a growing appreciation for the value of the biological world (on its own terms outside of any practical human use) that faintly echoes the notion of connectedness with the natural world, which provided the underpinnings of native thought.

Major Changes

The nature and extent of human interaction with the environment changed permanently and abruptly in the middle of the nineteenth century. The native ecology included the influence of small-scale, non-agricultural, traditional human societies. After 1850, the local ecology was increasingly influenced by the actions of a large-scale, market-driven, industrial society. This industrial society brought about permanent transformation in certain aspects of the native ecology through intended and unintended consequences of human action.

The transformation from a small-scale society closely integrated with the analysis area to a large-scale industrial society where interactions within the watershed are frequently driven by outside concerns has been a fundamental and permanent change. These changes have included alterations in population, technology, economy, and worldview. Yet, the realization that there is an important place for local knowledge, local community action, and flexible management practices may lead to human interactions that are appropriate to local ecological conditions, and like the native system, are sustainable over the long term.

Trends

The analysis area is thoroughly integrated into the regional and national land management system. Human interactions in the analysis area will continue to reflect national economic and political goals. In addition, trends include greater movement of populations to rural areas. This trend has increased concern about community issues and local environmental conditions. The future may see more flexible land management policies developed through partnerships with local residents and people, including federal employees, who work closely with the land.

The capability for this type of flexible management is currently high. Conflicts are worked out through local partnerships incorporating local residents, federal managers, and local and national economic and political entities. The adaptive management strategy allows greater flexibility necessary to adapt national programs and goals to local conditions and concerns.

ROADS

Roads influence many ecosystem processes including soil productivity, wildlife distribution, the hydrologic network, channel morphology, water quality, and aquatic habitat. Forest roads diminish soil productivity by taking the area they occupy out of production. To put this in perspective, four miles of road per square mile is roughly equivalent to removing 10 acres from production. There is no natural occurrence that can be compared to road construction. Road surfaces are out of production as long as they are maintained. When road maintenance stops, vegetation may become established; however, the growing rate is far less than for undisturbed soil.

Roads affect wildlife in two primary ways: habitat removal and altered behavior patterns. Road construction inevitably removes habitat for various wildlife species. In addition, habitat within varying distances of roads is not used to the extent it would be if the roads were not

present. This may have a far greater impact on wildlife than the immediate loss of habitat. For example, there are approximately 58 miles of secondary roads in the Applegate-Star/Boaz Watershed Analysis Area. Using a standard 7 acres per mile of road, which includes clearing limits, approximately 400 acres (7 percent) of habitat in the analysis area have been lost to roads. In comparison, using a somewhat generally accepted value of 200 feet as the area of influence of secondary roads open to vehicles on big game and given there are approximately 50 miles of roads open to vehicle use, one could expect reduced use of habitat on approximately 2,400 acres (22 percent) of the analysis area. There is little disturbance to wildlife from roads that are closed to vehicles. Vehicle use is the primary cause of altered wildlife behavior patterns.

By altering the hydrologic network, roads cause increases in the magnitude of peak flows and change the timing when runoff enters a stream. The actual effect of roads on peak flow magnitude and timing is dependent on the number, size and location of drainage facilities, and rainfall intensity and duration on a given road system.

Roads adjacent to stream channels confine the channel and restrict the natural tendency of streams to move laterally. This can lead to downcutting of the stream bed and streambank erosion. Road crossings can constrain the channel with culverts that are too narrow. This increases water velocities and/or stream gradient, often blocking fish migration through the culvert.

Roads through riparian areas reduce riparian habitat, limit the number of trees that fall into streams, and decrease shading.

Road surfaces, fill slopes, and ditchlines are the primary sediment sources in the analysis area. Road stream crossings and unsurfaced roads that parallel stream channels contribute the greatest amount of sediment to streams. Fine sediments clog spawning gravels and fill spaces between cobbles, detrimentally affecting instream habitat.

EROSION PROCESSES

Natural surface ravel results from geologic uplift. Greater prehistoric uplift rates resulted in more surface ravel on very steep slopes than the present time. High intensity storm events are a natural cause of concentrated water erosion. Soil type and vegetative cover determine the extent of rill or gully erosion resulting from high intensity storms.

Intense natural fires that eliminate vegetation from very steep, gravelly slopes tend to increase ravel movement rates and concentrated flow erosion rates. Prior to fire suppression, fire intensities were low and probably did not result in large areas of bare soil and subsequent ravel movement or gull/rill formations. Current vegetative conditions resulting from fire suppression are prone to high intensity fires, such as the 1987 Star Gulch fire.

Large intense fires that were started by settlers and miners in the late nineteenth century and early twentieth century may have increased ravel movement rate and ravel thickness on lower

slopes and in draws. The increase in intermittent stream peak flows following these fires also would have increased gully erosion rates, especially on moderate slopes closest to mining activities and new farms.

Amounts and rates of erosion can be accelerated by management activities, such as timber harvest and road construction. Units harvested within the past 20 years are predominately located in the Benson, Lightning (including adjacent frontal area), Alexander, and Upper Boaz gulches. Roads can concentrate water and route it to bare sideslopes resulting in rill or gully formation. Eroded soil can be a source of fine sediment to the stream system. Specific erosion sites need to be identified. Overall, erosion has increased from historical low cyclical rates to low-to-moderate rates primarily due to timber harvest and road construction. Erosion rates have not been quantified.

Erosion processes are interconnected with other ecosystem elements, such as hydrology, plant communities, and disturbance processes. Erosion from concentrated flow is dependent on soil infiltration rates. Gravelly loam soils in the very steep upland portions of the analysis area have high infiltration rates that can accept all but the most intense rainfall rates without water accumulating at the surface. On the other hand, Vannoy silt loam, which occurs on moderate slopes, has a lower infiltration rate, allowing storm water to accumulate on the surface more often, and resulting in conditions that may lead to overland flow erosion. Draws may develop from overland flow and tend to migrate upslope.

Development of plant communities and wildlife habitat is tied to erosion processes by the degree of soil building versus soil loss. Factors affecting soil building or loss include slope shape and position, aspect, climate, and disturbances such as windthrow and wildfire. In areas where soil loss is at a rate greater than soil development, such as in the McMullin-Rock Outcrop area, plant rooting depth and soil productivity is minimal. Plant species in these shallow soil areas are limited to certain grasses, forbs, and shrubs, which provide optimal deer forage. On steep slopes where ravel commonly occurs, plant establishment and growth are limited. Douglas-fir on north slopes and deerbrush on south slopes have proven to be adept at growing in these conditions. Disturbances expose mineral soil, which may result in soil loss until plants reestablish.

SOIL PRODUCTIVITY

Soil productivity is especially critical in portions of the area where precipitation is marginal for conifer growth. Natural influences on soil productivity changes include wet and dry climate cycles. During dry cycles, trees lose vigor and may die; during wet cycles, trees gain vigor. South-facing slopes are particularly susceptible to wet/dry cycles. Conifers, especially ponderosa pine, may survive on south slopes during wet cycles. During dry cycles, soils on south-facing slopes (where exposure to solar radiation is highest) are the driest; therefore, soil productivity is very low and does not support conifers (Map 8). The dead and dying trees commonly seen on south-facing slopes and ridges are a result of the recent drought period. Though some mortality due to drought occurs, the same soils have higher productivity on north slopes and are able to maintain healthier, more vigorous conifer stands. This is a result

of lower solar radiation, more shade, lower temperatures, and less evapotranspiration.

Intense wildfires that tend to occur during dry cycles can deplete organic matter and consequently reduce soil productivity. The 1987 Star Fire (Map 21) provides an example of soil productivity loss due to intense wildfire. Under natural fire regimes, a nutrient balance is maintained among organic matter, coarse woody material, and fire. Where low intensity, high frequency fires occur, organic matter and coarse woody material losses are minimized, which reduces the potential for a high intensity fire.

Trees blown over by winds (windthrow) can diminish soil productivity due to soil displacement. The potential for windthrow increases under saturated or near-saturated soil conditions and in shallow soils with minimal rooting depths. Trees in a dense forest stand reduce the wind force; whereas stands where timber harvesting has removed the natural stand structure have greater windthrow potential. Windthrown trees pull up root wads displacing soil, which results in holes two to three feet deep and several feet across. These holes may serve as reservoirs of moisture in spring and early summer for plants and animals.

There is no known study that quantifies natural surface disturbance effects on long-term soil productivity. Natural disturbances serve to maintain or enhance soil productivity in the long term. Fire, for example, may cause an immediate reduction in soil productivity at a specific intensely burned site, but the fire simultaneously reduces fuel loading. Until the fuel load (vegetation) builds back up, the extent of future high intensity fire is reduced. Fire also thins vegetation providing more soil moisture for the remaining vegetation. Windthrow can be viewed similarly. When a tree is blown down, that tree is lost as a part of the growing vegetation. However, there is a gain in terms of coarse woody material and possible water conservation because less water is lost through transpiration. A healthy ecosystem is resilient and it can withstand the effects of the most intense natural disturbances (Amaranthus 1996).

Tractor logging generally causes compaction at depths of 4 to 12 inches. Compaction reduces soil productivity by increasing soil bulk density, reducing pore space, and increasing resistance to root penetration, which slows plant growth. Less than 3 percent of the analysis area has been tractor logged.

Erosion usually removes duff and surface mineral soil, which reduces soil productivity. For the analysis area, soils most susceptible to productivity losses are derived from granite (Tallowbox soil) and the moderate sloping Vannoy and Voorhies soils (Map 7). The duff layer is especially critical for Tallowbox soils because it provides protection for the highly erodible mineral soil and is a long-term nutrient source (USDA 1993).

VEGETATION DENSITY AND VIGOR

Vegetation in the Applegate-Star/Boaz Watershed Analysis Area is dominated by forest land and shrubland; grasslands and oak woodlands were more prevalent in the past. Historically, forest land that consisted of large diameter Douglas-fir, pine and cedar stands with few stems per acre has changed to smaller diameter, densely stocked Douglas-fir stands. These stands

are closed-canopy, single layered and in the late seral stage, with many stems per acre (200 to 600). The multi-layered, late seral stands of the past have mostly disappeared. The remaining stands have single old-growth trees scattered across the landscape. The current overstocked stand conditions have increased the rate of insect and disease mortality and have often eliminated less competitive species from their historic range.

As the human population increased, the pattern of natural disturbance shifted. Historically, fire and weather were the primary disturbances affecting the area. As human habitation increased, logging practices and fire suppression began to contribute to a long-term change in the ecosystem. Logging practices and fire suppression have fundamentally altered the structure and species composition of the analysis area. Fire suppression eliminated a major component of successional change. With the elimination of fire came overstocking and species/seral stage shifts; a trend that will continue as the human population continues to impact the analysis area.

As stands become overstocked and lose vigor, bark beetles invade and increase mortality. This results in accelerating the succession process. Dwarf mistletoe is contributing to the death of large diameter Douglas-fir trees. In the past, relatively short fire return intervals reduced overstocking and aided in accelerating the cycling of nutrients. With the exclusion of fire, more organic matter remains on the forest floor, slowing down the nutrient cycling process. This may contribute to the declining vigor of the stands because certain nutrients are not as readily available to the vegetation. Growth patterns have changed from the historic conditions. The lack of natural disturbance (fire) has led to increased vegetation densities which, combined with a natural drought cycle, has contributed to the decrease in growth. Past logging practices have contributed to the changes in species composition and seral stage by continually removing older trees. Seral stages are also influenced by natural succession, fire suppression, natural disturbances, and mortality.

The increased natural mortality throughout the stands will result in more woody material. This fuel loading will increase the probability and intensity of future fires. Intense stand replacing fires would affect the analysis area's capability to achieve desired management goals.

Vegetation species will continue to shift naturally and also through management, creating a desired future landscape consisting of variable seral stages and condition classes. These desired conditions can be achieved through proper fire management, frequent and varied silvicultural practices, and species management. Map 22 shows appropriate tree series for the analysis area.

PLANT SPECIES AND HABITATS

Special Status Plant Species and Habitats

Special status plant species have declined in the Applegate-Star/Boaz Watershed Analysis Area due to modification and habitat loss from a variety of human activities. These include timber harvesting, road building, and conversion of native plant communities to domestic and agricultural use. Such activities have reduced or eliminated populations by: 1) fragmentation

and physical disturbance of micro-habitats and creating edge effects, which change temperature and moisture regimes (Chen et al. 1995); 2) reducing present and future supplies of coarse woody material; 3) decreasing pollinator abundance; and 4) introducing non-native plants and noxious weeds. Natural functions and processes have been altered in many places in the analysis area.

Fire suppression, which has occurred since the early 1900s, is another factor that has changed population dynamics and may have contributed to the decline of populations of some special status plant species in the analysis area. Frequent low intensity fires create openings for new plants to become established, decreases competition, and increases site productivity. Current data exists on populations of *Cypripedium fasciculatum*, which show a decline in vigor and numbers of plants from pre-harvest to post-harvest in clearcut units in Alexander Gulch. Table 20 lists the special status plant species and the habitats in which they are found in the Applegate-Star/Boaz Watershed Analysis Area.

Table 20. Special Status Plant Species and Their Habitats

Species	Habitat
<i>Cypripedium fasciculatum</i> , <i>Cypripedium montanum</i> , and <i>Sedum radiatum</i> ssp. <i>depauperatum</i>	Forest, riparian
<i>Fritillaria guthriei</i>	Oak woodland, grassland
<i>Fritillaria guthriei</i> and <i>Lonicera interrupta</i>	Shrubland
<i>Lewisia corymbosa</i> var. <i>howellii</i> , <i>Sedum laxum</i> ssp. <i>heckneri</i> , and <i>Sedum obovatum</i>	Rock

Habitat conditions should improve with the current management direction given by the Medford District Resource Management Plan (USDI 1995a) and the Northwest Forest Plan (USDA and USDI 1994a). Future projects should have positive effects on special status plant habitat. These projects will include: forest stand density management, reintroduction of fire through controlled burns, retention of 15 percent of mature/old-growth timber stands, dispersal corridors, and developing conservation strategies for individual species. Riparian Reserves will contribute to improved habitat conditions for some species. On private land, a downward trend will likely continue due to the increasing demand for timber, land development, and water use.

Survey and Manage Plant Species and Habitats

A non-vascular plant survey conducted during Autumn 1997 through Spring 1998 located ten Survey and Manage species: three species of fungi, six species lichens, and one species of bryophyte (Table 6, Characterization). Baseline data does not exist for these species in the Applegate-Star/Boaz Watershed Analysis Area. There has already been a large modification of the habitat in which they would occur.

Past disturbances, especially logging and road building, seem to affect the fungi species more

than the lichens and bryophytes. These fungi species occur in the older, closed-canopy forest stands where stand manipulation changes the understory microclimate. The lichens and bryophyte species are mostly common riparian community components. Changes to the riparian habitat appear to narrow the suitable habitat, however, these species survive if larger host trees (typically hardwoods) remain.

The two Survey and Manage vascular plant species that occur in the analysis area (*Cypripedium fasciculatum* and *Cypripedium montanum*) are also special status species. They both have declined due to habitat modification, primarily from timber harvesting (see Special Status Plants).

Habitat conditions should improve with current management direction through developing conservation strategies, implementing Survey and Manage protocols, maintaining mature/old-growth patches across the landscape, and using fire for habitat improvement. Riparian Reserves should improve habitat conditions for some species. On private land, a downward trend will likely continue due to increasing demand for land development, timber, and water use.

Noxious Weeds

Little is known about the distribution of noxious weeds within the Applegate-Star/Boaz Watershed Analysis Area. Noxious weed populations appear to be increasing. Based on current knowledge, the economical and ecological elimination of some species, such as yellow starthistle, is unlikely. Noxious weed populations must be located to increase the effectiveness of control efforts. The Oregon Department of Agriculture is focusing research on identifying biological control agents. Biological control agents are successful at controlling some species (e.g., tansy ragwort). This control method appears promising for several other species, however, it is still too early to draw any definitive conclusions.

FIRE

Historically frequent, low intensity fires maintained most valley bottomlands and foothills as grasslands or open savannas. Forests created from frequent, low intensity fires have been described as open, park-like, uneven-aged stands, characterized by a mosaic of even-aged groups. Douglas-fir, ponderosa pine, sugar pine, and white fir were the most common species. All four of these species are resistant to fire as mature trees. As saplings, ponderosa pine is the most resistant followed by sugar pine, Douglas-fir, and white fir. Frequent fires had major structural effects on young trees favoring ponderosa pine as a dominant species and white fir as the least dominant in this forest type.

Fire suppression over the past century has effectively eliminated five fire cycles in southwest Oregon mixed conifer forests (Thomas and Agee 1986). The absence of fire has converted open savannas and grasslands to woodlands and initiated the recruitment of conifers. Oregon white oak is now a declining species largely due to fire suppression and its replacement by Douglas-fir on most sites.

Fire-intolerant and shade-tolerant conifers have increased and species, such as ponderosa pine and sugar pine, have declined. This conversion from pine to true fir has created stands that are subject to stress, making them susceptible to accelerated insect and disease problems (Williams et al. 1980).

Horizontal and vertical structures of the forest have also changed. Surface fuels and the laddering effect of fuels have increased, increasing the threat of crown fires that were historically rare (Lotan et al. 1981). Fire suppression changed a low severity fire regime to a high severity regime, which is characterized by infrequent, high intensity, stand replacement fires. Wildfire is an agent of ecosystem instability because it creates major shifts in forest structure and function on a large scale.

TERRESTRIAL WILDLIFE SPECIES AND HABITATS

Wildlife - General

Vegetative conditions are the primary influence on terrestrial populations and their distribution within the analysis area. A variety of processes have changed vegetative conditions over time, including natural and human-caused disturbances and natural succession.

Current conditions in the analysis area differ from reference (historical) conditions primarily due to fire suppression and timber harvest. A direct comparison of the relative abundance of current and reference condition vegetative conditions is not possible. Table 21 shows comparison of the 1947 vegetation mapping and current vegetation conditions.

Table 21. Comparison of Reference and Current Condition Habitat Acres

Habitat/Condition Class	1947 Reference Condition Acres (%)	Current Condition Acres (%)
Grass, forbs, herbaceous vegetation	1,895 (11)	1,170 (7)
Shrubs/hardwood/woodland	4,640 (26)	4,575 (26)
Early seral	1,838 (11)	1,511 (9)
Poles (5-11" dbh)	965 (5)	2,287 (13)
Mid-seral (11-21" dbh)	2,784 (16)	5,907 (33)
Mature/old-growth	5,528 (31)	2,200 (12)

Although acreage used in this comparison may not be exact due to the differences in definitions and descriptive terminology used in the mapping, it is apparent there have been major shifts in the relative abundance of pole, mid-seral, and mature/old-growth habitats. It can reasonably be assumed that the abundance and distribution of wildlife species preferring these habitats have also changed in response to these shifts.

The following generalizations can be made in the comparison of current conditions to reference conditions.

Populations of species preferring the structure and conditions provided by the mature/old-growth condition class have likely declined. This condition class has historically provided the bulk of the timber and it has been removed faster than it can be replaced.

Habitat quality in the mid-seral condition class has declined. Historically, this condition class had a less dense canopy due to fires. The open canopy allowed the establishment of understory vegetation. Due to fire suppression, many stands in this condition class now have a high degree of canopy closure and sparse understory vegetation. Stands with multiple vegetative layers are used by approximately twice as many vertebrate terrestrial wildlife species as those with dense canopies and sparse understory vegetation (Brown 1985).

Most of the current early/seedling-sapling and pole habitat is the result of timber harvest; consequently, snags and coarse woody material are lacking. Except for the lack of snags and coarse woody material, these condition classes appear to be in relatively good condition. Populations of species that require snags in these condition classes have likely declined, while populations of species not requiring snags may have increased.

The absence of fire has allowed much of the oak-woodland habitat to become overstocked and has also allowed conifers and shrubs to encroach on them. Both processes have resulted in increased mortality, reduced growth, and diminished mast (acorn) production. Large oaks, which provide natural cavities and acorns, are important to a variety of wildlife species. Populations of those species that utilize these features of the oak-woodlands have probably declined.

The quality of shrubland habitat has declined due to fire suppression. Generally, fire is the primary agent for creating early seral stages in this plant community. In the absence of fire, much of this habitat type has matured and early seral stages are deficient.

The quality and quantity of grass/forbs/herbaceous habitat has declined due to the invasion of noxious grasses and forbs and the encroachment of shrubs and conifers, respectively. This decline in quality and quantity of habitat has had an adverse impact on herbivores in the analysis area.

Overall, it is apparent that many species have been adversely affected by a general decline in habitat quality within the analysis area. Loss or modification of habitat is probably most pronounced in the mature/old-growth condition class, and wildlife species associated with this habitat have likely been the most affected.

Under current management direction, habitat condition could improve in some condition classes on BLM-managed lands in the analysis area. Treatment of mid-, mature, oak-woodland and shrubland condition classes have high priority. Recommended treatments in these condition classes include thinning over-dense stands in the mid-, mature and oak-woodland condition classes, and converting portions of the shrublands to early seral

conditions. Thinning in the overstocked mid- and mature condition classes will improve structure by promoting individual tree growth and the development of understory vegetation. These treatments may accelerate recruitment into the mature/old-growth condition class. Thinning oak-woodlands should promote both growth and acorn production. Vegetative diversity and browse conditions for black-tailed deer should improve as a result of converting a portion of decadent shrublands to early seral conditions.

If the thinning strategy in the mid- and mature condition classes is maintained over time, a decrease is likely in the frequency of relatively large patches of early seedling/sapling and pole condition classes of the mixed conifer forest. This could adversely affect species that prefer these habitats and result in reduced vegetative diversity on a rather large scale. Although data on patch size utilization by species preferring these habitat types are lacking, large patches are necessary for some species due to home range size/territory. The primary processes that produce these larger early seral patches are wildfire and regeneration types of timber harvest. Assuming fire suppression, fire hazard reduction, and harvest methods other than clearcutting remain high priority management objectives on BLM-managed lands, there will be only minor development of large patches of early seral mixed conifer forest in the analysis area.

Threatened/Endangered Species

Northern spotted owls are associated with the mature/old-growth condition class. The decrease in the abundance of this condition class from historic levels to present levels is quite substantial (Table 21). Due to this decrease in preferred habitat, it can reasonably be assumed that northern spotted owl populations are lower than they were in the historic period. The actual change cannot be quantified, however, available data since 1973, indicate that at least one pair of owls has been lost. This loss was quite likely associated with timber harvest.

Bald eagles probably used some portions of the Applegate River within the analysis area for opportunistic feeding. Some feeding still occurs, but probably to a lesser degree than in historic times due to diminished anadromous fish runs.

Northern Spotted Owl Critical Habitat

Northern spotted owl critical habitat was not designated until 1992. Prior to that time, critical habitat received the same types of treatment as other areas within the analysis area. With the designation of critical habitat, the management emphasis in critical habitat was protection and enhancement of habitat conditions in order to provide for clusters of reproductively capable spotted owls. With the adoption of the Northwest Forest Plan (NFP) in 1994, the issue of providing for clusters of owls in critical habitat outside of Late-Successional Reserves (LSR) (the areas under the NFP that are to provide the clusters of owls) is somewhat moot, since the Forest Plan is being recognized as the Federal contribution to recovery of the northern spotted owl. The primary function of critical habitat in the analysis area, which is outside of any LSR, is to provide for spotted owl dispersal/connectivity between the Late-Successional Reserves established in the NFP.

Survey and Manage, and Protection Buffer Species

Two of the survey and manage species, Siskiyou Mountains salamander, (also a talus obligate) and red tree vole, seem to prefer mature/old-growth habitat. Due to this apparent affinity, the reduction of mature/old-growth habitat in the analysis area has likely resulted in the population declines for these species.

Because great gray owls appear to have just recently expanded their range into the analysis area, it is not clear at this time how resource management and natural disturbances have affected this species, or what influence future management will have on them.

Since so little is known about the five Survey and Manage molluscs that might be present in the analysis area, and no surveys have been conducted, the implications of past and future disturbances on these species are not known.

Although there are numerous unknowns for these Survey and Manage and Protection Buffer species, the protective measures prescribed for them in the NFP should at least maintain and possibly improve habitat conditions in the future.

Special Status Species

The decrease in mature/old-growth habitat via timber harvest is primarily responsible for the listing of at least 10 of the 21 special status species found in the analysis area (Table 12). These species prefer mature/old-growth mixed conifer forest for feeding, breeding, and/or sheltering. As Table 21 indicates, there has been a considerable decrease in abundance of this habitat in the analysis area. Due to the habitat loss, populations of these species have likely declined.

The western bluebird and western meadowlark are also considered special status species due to the decline in habitat conditions. Urbanization, salvage logging (which removes potential nest sites), and competition with other bird species for nest sites are some of the causes for the demise of western bluebird populations (Marshall et al. 1996).

Western meadowlarks in the analysis area are associated with agricultural lands and low elevation grasslands. These habitat acres have remained constant over time and populations have probably not changed to any great extent. Urbanization is a primary threat to the western meadowlark populations but it is not a concern in the analysis area at this time.

As indicated in Table 12, general rarity and a lack of information are the primary reasons for listing the other species as special status. In comparing historic to current conditions, little can be inferred for these species because little is known about their habitat affinities.

HYDROLOGY

The streamflow regime in the Applegate-Star/Boaz Watershed Analysis Area reflects human influences that have occurred since Euro-Americans arrived.

Road construction, timber harvest, and fire suppression are the major factors having the potential to adversely affect the timing and magnitude of streamflows in Star Gulch. Changes in the streamflow regime due to human disturbance have not been quantified in Star Gulch. The streamflow gaging station in Star Gulch has only been in place since 1983 and most of the operating time has been during an extended dry period.

Extensive road building and timber harvest in Star Gulch (from 1960-1990) have raised the potential for increasing the magnitude and frequency of peak flows in the tributaries and main stem. The effect of this increase is not very significant at present for two reasons: the area has experienced an extended period of below normal rainfall, and the soils within the watershed are very stable. If the climate moves into a wetter cycle, the effects of the roads and harvest on bankfull discharge, stream channels, and water quality may become more apparent. Potential changes may include channel widening, bank erosion, channel scouring, and increased sediment loads. These are normal occurrences in a dynamic, properly functioning stream system; however, increases in the magnitude and frequency of peak flows due to human-caused factors can magnify the effects. Openings in the transient snow zone are of particular concern as they tend to produce higher streamflows during rain-on-snow events. As vegetation planted in the harvested areas recovers, the increases in magnitude and frequency of peak flows will diminish. Permanent road systems intercept surface runoff and subsurface flow, which prevents the streamflow regime from returning to predisturbance levels.

Fire suppression has resulted in areas of dense vegetation throughout Star Gulch watershed. These areas remove more water from the soil through transpiration, resulting in decreased water availability for streams and subsurface flow during the summer low flow season. This trend will continue until the areas are thinned either manually or by a wildfire.

For the Applegate River corridor area, the Applegate Dam and water withdrawals have had the greatest impact on streamflows. The Applegate Dam has moderated Applegate River streamflows at both ends of the spectrum. Peak flows are fewer and smaller and there are fewer extreme low flow conditions. Water diversions from the Applegate River, primarily for irrigation, have contributed to summer flows not meeting the established minimum streamflow. There are also densely vegetated areas in the Applegate frontal drainages, which could be contributing to depletion of summer low flows in the tributary streams.

STREAM CHANNEL

Channel conditions and sediment transport processes in the Applegate-Star/Boaz Watershed Analysis Area have changed since Euro-American settlers arrived in the 1830s primarily due to mining, road building, and removal of riparian vegetation. Hydraulic mining resulted in

entrenched channels with greater width/depth ratios. Increases in stream gradients and sediment loads were a consequence of these larger width/depth ratios.

Sediment is mainly transported to streams from non-paved road surfaces, fill slopes, and ditchlines. Increases in road-produced sediment loads are generally highest during a five-year period after road construction, however, roads continue to supply sediment to streams as long as they exist. Road maintenance, stabilization, and decommissioning would reduce the amount of sediment moving from the roads to the streams. Roads are constructed adjacent to many stream channels in the analysis area, including Star, Ladybug, Lightning, and Boaz gulches, and the Applegate River. These roads tend to confine the stream/river and restrict their natural tendency to move laterally. This has led to downcutting of the streambed and bank erosion. Obliteration of streamside roads or moving them upslope would improve the situation.

Removal of riparian vegetation has had a major detrimental effect on the presence of large woody debris in the stream channels. There is a minimal amount of large woody material in the analysis area with many areas lacking the potential for short-term future recruitment. Large woody debris is essential for reducing stream velocities during peak flows and for trapping and slowing the movement of sediment and organic matter through the stream system. It also provides diverse aquatic habitat (see Current Conditions, Aquatic Wildlife). Establishing Riparian Reserves along intermittent, perennial nonfish-bearing, and fish-bearing streams will provide a future long-term source of large woody debris recruitment for streams on federal land. It may take 100 to 150 years for riparian conifers to become a source of large woody debris in areas that have been harvested.

WATER QUALITY

Changes in water quality from reference to current conditions are predominantly caused by riparian vegetation removal, water withdrawals, and roads. Water quality parameters known to be affected most by human disturbances are temperature, sediment, and turbidity. Lack of riparian vegetation and water withdrawals have contributed to high summer stream temperatures that can stress aquatic life in the analysis area. Summer water temperatures for both the Applegate River and Star Gulch exceed the State temperature criterion and qualify them for designation as "water quality limited" streams. Roads are the primary source of sediment for streams in the analysis area. Turbidity is generally very low in Star Gulch and its tributaries, except during high flow events.

Protection of vegetation providing stream shade and recovery of riparian vegetation should bring about the reduction of stream temperatures in Star Gulch. Water temperatures are likely to maintain the same pattern in the Applegate River due to withdrawals, high width-to-depth ratio, and lack of riparian cover. Road maintenance, stabilization, and decommissioning would decrease sedimentation and turbidity in Star Gulch.

RIPARIAN AREAS

Natural watershed characteristics (aspect, valley shape) and human activities (trapping beavers, mining, roads, logging, agriculture, irrigation canals, and introduction of exotic plants) influence riparian condition, and therefore, riparian plant and animal communities.

Aspect affects the amount of sunlight getting to a riparian area, also affecting riparian soil and air temperatures and humidity. Soil productivity is directly related to soil temperature. Productivity increases until soil temperatures become too hot for soil bacteria and fungi. Air temperature and humidity directly influence the distribution and diversity of riparian plant species. Aspect also limits riparian-dwelling animals' ability to disperse. For example, animals that dwell in cooler, damper, north-facing riparian areas may not be able to colonize in a hotter, drier, south-facing riparian area. Therefore, connections between similar aspects are important.

Valley shape affects the amount of light and heat in a riparian area. It also affects stream channel shape and a stream's flood response. For example, a steep V-shaped valley tends to have a stream with a narrow floodplain. The plants on the floodplain will probably be able to handle frequent flood events.

Loss of beaver eliminated an important component of valley-bottom river systems. Beaver dams store nutrients, the basic level of "food" in the aquatic food chain. Beaver marshes provide a constantly shifting mosaic of riparian habitat. As dams were breached in floods, beaver rebuilt them in different places. Water levels varied and wetland and riparian plants grew in patches throughout the landscape. The diversity of riparian habitat was severely reduced when beaver were eliminated from the area.

Historical mining cleared and disturbed the riparian area, eliminating habitat for riparian-dependent animals and plants.

Riparian roads eliminate a swath of riparian vegetation, narrowing riparian areas. When roads are built on south-facing slopes, vegetation shading the riparian area is removed, sometimes causing the riparian area to "dry out."

Logging in riparian areas removes or reduces the canopy protecting cool air temperatures and humidity to which riparian plant and animal communities have adapted. Logging has removed many large-diameter fallen logs from riparian areas. These logs store water, which helps regulate riparian humidity; contributes nutrients; and provides habitat for many plants, insects, and animals.

The conversion of willow thickets, beaver marshes, and cottonwood groves to farmland along the Applegate River reduced the riparian area to a narrow strip along the river. Early settlers channelized the Applegate River in the floodplain in an effort to protect buildings from floods. Habitat for a large variety of riparian plants and animals was lost or severely reduced.

Small tributaries on both the east and west sides of the river drain into irrigation canals. There

is no connection of the tributary channel or riparian area to the mainstem Applegate River, contributing to habitat loss, as well as corridors for movement of riparian species from the Applegate River into side drainages.

Exotic plants have changed riparian plant communities. An obvious example is the introduction of Himalayan blackberry, now the dominant understory plant in much of the Applegate riparian area. Blackberries do act as "natural barbed-wire," and do provide a food source for some animals and people. However, they choke out the native riparian plants, especially willows. Willows stabilize the river and stream banks more effectively than blackberries. As evidenced in the 1997 New Year's Flood, banks held only by blackberries were easily eroded. Willows also provide extremely important habitat for hundreds of bird species, especially neotropical migratory birds (birds that migrate from the Arctic to the tropics every year). Blackberry dominated riparian areas produce fewer insects and provide less nesting habitat than willow dominated riparian areas. Insects are a critical food source for migrating birds and young nestlings. Willow leaves provide forage for many other wildlife species.

Effects on Aquatic Habitat

The changes in riparian areas also affect aquatic habitat. The lack of large-diameter trees affects the supply of large-diameter wood to streams, which determines the amount of habitat. Therefore, summer, winter, and spawning habitat is limited. Confining the stream channel and reducing riparian cover contributes to high water temperatures, making the environment more favorable for exotic warmwater fish species, such as smallmouth bass, largemouth bass, bluegill, pumpkinseed, and dace; these species compete with native cold-water species, such as trout, salmon, steelhead, lamprey, suckers, and sculpin.

Most information gathered on riparian systems has been along fisheries streams. Very little information exists regarding the condition, function, and ecological importance of riparian systems along intermittent and ephemeral streams. There is also a lack of information on the differences between north-facing and south-facing streams and conifer-dominated or oak/brush-dominated riparian plant communities. This lack of information is a limiting factor in properly managing an integral component of ecosystem "health" and integrity.

On the Applegate River, the limiting factors preventing the long-term sustainability of riparian communities are: the loss of space for and diversity of riparian habitat, the loss of floodplain access, the introduction of exotic plants, and the separation of tributary riparian areas from the main channel. In Star Gulch, the limiting factors are: the loss of space for and connection between riparian habitats (primarily from roads), the lack of large-diameter conifers, and the loss of the cool riparian environment in logged or roaded areas.

There is not much species-specific information available on riparian dependent plant or animal species. However, the emphasis for federal land managers is on protecting all of the components of the riparian ecosystem in order to protect habitat for the diverse riparian community.

AQUATIC WILDLIFE SPECIES AND HABITATS

Natural watershed characteristics (aspect, valley shape, gradient) and human activities (removing beaver, mining, roads, stream cleaning, Applegate dam and irrigation) influence stream and river conditions and therefore, aquatic communities.

Aspect affects the amount of solar radiation reaching the stream. The amount of solar radiation (heat and light) affects stream temperatures and plant community types, and both directly and indirectly, the presence of insects, amphibians, and fish.

Valley shape affects a stream's flood response. Streams in narrow V-shaped valleys, like Star Gulch, sometimes "scour out" in floods because floodplains are limited or non-existent. Animals living in such a stream must withstand rolling rocks and high flood velocities.

Gradient limits which species can colonize a stream. Some aquatic species, such as cutthroat trout, lamprey, and Pacific giant salamanders, can easily handle high gradient streams, while others such as chinook, sculpin, western pond turtles cannot.

The absence of beaver has reduced slow-water habitat and small side channels. Beaver ponds are excellent fish habitat, especially for juvenile fishes. Western pond turtles, herons, frogs, and other pond-dependent or pond-preferring species are undoubtedly less common in the Applegate River now that the beaver are gone. In addition, removing beaver has reduced the nutrient-holding capacity of the river, and a corresponding suite of insects and other animals at the "bottom" of the food chain for fish species.

Historical mining confined channels, encouraged channel downcutting, destroyed riparian areas, and removed trees, which contributed to habitat degradation. Small suction dredges do not cause as much damage as large-scale mining. However, dredging does loosen and displace the spawning gravels. Fish spawn in the mining gravels left in pools; these gravels are washed out every year during high flows, and therefore redds are lost (Lisle 1995).

Unsurfaced roads that parallel streams and road crossings contribute fine sediments to streams and rivers. Erosion begins in the upper reaches of a road system with storm events transporting sediment to streams via road systems. Road maintenance can contribute fine sediments; for example, graders scrape soil into streams or into road side areas where rainfall transports it down gullies into streams.

Fine sediments have a cumulative impact on water quality. Small amounts of sediment from many roads cause severe stream sedimentation. Fine sediments clog spawning gravels, choking alevins in redds, making it difficult for them to emerge. Fine sediments also fill spaces between cobbles, reducing cover for fish, amphibians, and insects. Lack of space for insects ultimately reduces available fish food.

As mentioned in the Hydrology section, road-related erosion has been noted in the headwaters of Boaz Gulch and Upper Star Gulch. According to 1993 surveys, the pools and glides (shallow pools) in Reach 6, downstream of Upper Star Gulch, have noticeably higher

percentages of sand and silt than the other reaches.

Removing wood from streams, especially long, large-diameter logs, reduces the amount of habitat-forming components in the creek. Logging eliminates the future supply of these logs. As logs are gradually washed downstream by storm events, they cannot be replaced by new material from the riparian zone (Bryant 1985). The end result is fewer pools, less spawning, summer rearing, and winter survival habitat.

Logging streamside trees removes shade, which increases stream temperatures. In systems that are naturally warm, this increase in water temperature can raise stream temperatures into ranges that are stressful for salmonids and other native cold-water fishes. The increased sunlight can create a short-term boost in productivity and a corresponding short-term boost in fish numbers due to the increased food supply. However, as summer temperatures increase, the fish move to cooler areas with pools. In the long term, salmonid populations will drop with streamside logging, due to temperature stress and loss of wood-created habitat.

In general, dams alter flows and temperatures, trap sediment, and contribute to river channelization (and therefore habitat simplification). The effects of the Applegate Dam may be both beneficial and harmful by providing some cool-water refugia during the summer months, trapping spawning gravels, and altering flow regimes.

Irrigation reduces the amount of water in the Applegate River and its tributaries during the summer. Low water creates higher summer water temperatures, which cause physiological stress for cold-water adapted species. Unscreened ditches are also a hazard for fish.

Ecosystem Processes

The changes in habitat and associated changes in the aquatic communities affect other ecosystem processes in the analysis area. Two examples are increased summer water temperatures and decreased salmon and steelhead runs. Warm temperatures in the Applegate River encourage the proliferation of introduced exotic fishes, such as largemouth bass. Largemouth bass are voracious predators, which has led to the demise of Western pond turtles, as well as native frogs.

Severely reduced salmon and steelhead runs in the Applegate River system have an impact on the rest of the aquatic ecosystem. Salmon and steelhead provided a huge nutrient boost to streams and the river when they died after spawning. Beaver ponds, slow/water side channels, and marshes helped store nutrients on site, instead of letting them quickly flow downstream to the sea. Changes in nutrients affect the very bottom of the food chain, and repercussions can be felt throughout the aquatic community. Oregon Department of Fish and Wildlife (ODFW) has begun to experiment with nutrient recycling to increase productivity by tossing dead salmon into small creeks near the Oregon coast.

Summary

In the Applegate River, the limiting factors for long-term sustainability of native fish and other

aquatic species are high summer water temperatures, lack of side channels and edgewater rearing habitat (especially for coho salmon), lack of winter habitat, and flood refugia. Introduced fish species like largemouth bass may also be a big problem, especially for juvenile fish.

In Star Gulch, the limiting habitat factors are the lack of and poor quality spawning, summer rearing, and winter habitat. Roads are the primary reason for the loss of large wood-formed pools, channel constriction, and increased sedimentation. Other limiting factors are high temperatures in the lower reaches, reduced large woody debris due to logging, and difficult access from the Applegate River for migrating steelhead.

Salmonids in the Applegate River are stable, but overall, populations are only remnants of what they once were. Other native fish species like lamprey, Klamath smallscale suckers, and sculpin are probably also in decline. In Star Gulch, the native cutthroat population appears to be stable, but not thriving. The steelhead population appears to fluctuate widely year to year. In dry years, very few adults even make it into the creek. Lamprey are sighted so rarely in Star Gulch that the spawning population may be very small.

River and stream conditions will have to be improved before the situation for salmon, steelhead, neotropical migrants, western pond turtles, and the whole aquatic/riparian ecosystem improve. To improve these conditions, it will require federal land managers and private land owners to work together.

MANAGEMENT OBJECTIVES AND RECOMMENDATIONS FOR FEDERAL LANDS

RESOURCE	OBJECTIVES	RECOMMENDATIONS	PRIORITY
HUMAN USES			
Economic Development	Produce a sustainable timber supply and other forest commodities on the Adaptive Management Area to provide jobs and contribute to community stability.	1. Conduct timber harvest and other silvicultural activities in that portion of the Adaptive Management Areas with suitable forest lands.	High
	Encourage opportunities for local contractors to compete effectively on contracts for projects in the analysis area.	1. Promote small-scale projects in forest, range, riparian, and other resources suitable for local administration and contractors.	High
	Maintain and develop opportunities for special forest products to facilitate community economic development consistent with other resource objectives.	1. Work with local groups to develop opportunities for the harvesting and sale of special forest products. 2. Encourage opportunities for local residents to compete effectively on contracts for projects in the analysis area.	Medium Medium
Public Involvement	Maintain and promote contacts with local groups, adjacent landowners, community leaders, tribal and public agencies to facilitate continuing dialogue on the management of public lands in the Applegate-Star/Boaz Watershed Analysis Area.	1. Continue to participate in Applegate Partnership activities. 2. Identify and incorporate tribal concerns, and keep tribes informed on land management activities in the analysis area. 3. Continue to encourage involvement of local interest groups and community leaders with land management practices and decisions. 4. Coordinate closely with the Forest Service on all management plans, projects, and activities within the analysis area. Seek Forest Service input and ensure reasonable consistency in actions across jurisdictional lines and within the analysis area boundaries.	High High High High

RESOURCE	OBJECTIVES	RECOMMENDATIONS	PRIORITY
Public Involvement (Continued)	Maintain and promote contacts with local groups, adjacent landowners, community leaders, tribal and public agencies to facilitate continuing dialogue on the management of public lands in the Applegate-Star/Boaz Watershed Analysis Area. (Continued)	- Utilize the "Applegator" and Public Information Office in Ruch to keep the public apprised of land management activities that occur in the area. - Make available scientific information regarding the analysis area to the local landowners and other publics. Develop an Internet "home page" and other means to disseminate information.	High Medium
Archaeology	Assess archaeological sites to determine their scientific and heritage value and protect or recover those values as necessary.	- Define the types of historic and Native American archaeological sites that are likely to occur within the analysis area. - Define the geographic areas where archaeological sites are likely to occur through construction of an archaeological sensitivity map. - Classify known sites according to BLM manual cultural resource use categories and manage accordingly.	High Medium Low
Recreation	Maintain dispersed recreational opportunities; utilize public input for planning priorities.	Continue to encourage dispersed recreational opportunities within the analysis area by working with the Forest Service and local interest groups.	Medium
Rights-of way	Cooperate with individuals, companies, Jackson County, State, Forest Service, and other federal agencies to achieve consistency in road location, design, use, and maintenance.	- Maintain and implement reciprocal road right-of-way agreements. - Implement road use and maintenance agreements. - Evaluate and provide road right-of-way grants. - Obtain road easements for the public and resource management.	High High High High
	Continue to coordinate with individuals, companies, nonprofit groups, counties, State, Forest Service and other federal agencies on all inquiries/applications for non-road rights-of-way, leases, permits, and exchanges on BLM-managed lands.	- Review each request on its own merits. - Ensure consistency, fairness, and legal/environmental compliance in all decisions.	High High
Unauthorized Use	Minimize and/or reduce unauthorized use, including dumping on BLM-managed lands.	- Continue coordination with State/county agencies to ensure resource needs on adjacent public lands are considered and accommodated in private actions. Utilize law enforcement resources when appropriate. - Review and prioritize backlog cases and take steps to resolve in a timely manner.	High Low

RESOURCE	OBJECTIVES	RECOMMENDATIONS	PRIORITY
Grazing	Manage livestock to maintain or improve Riparian Reserves in order to meet the goals of the Aquatic Conservation Strategy.	1. Stress the importance of properly functioning riparian areas in the issuance of grazing authorizations. 2. Implement Best Management Practices to ensure movement toward land use objectives.	High High
	Continue to provide livestock forage on designated allotments to meet societal needs without compromising the ecological integrity of the uplands.	1. Develop management strategies in consultation with the permittee to resolve resource conflicts that arise. 2. Maintain a list of vacant allotments, including specific management constraints and concerns, for future inquiries.	High Medium
Mining	Continue to coordinate with individuals, companies; county, State, and other federal agencies on all inquiries/applications for mineral exploration and development on BLM-managed lands.	1. Accept and process all mining claims. 2. Ensure that appropriate rehabilitation plans are part of any future operations and that these plans conform to watershed management objectives.	High High
ROADS			
Transportation	Manage the transportation system to serve the needs of the users and meet the needs identified under other resource programs.	1. Develop and maintain a road closure management plan. 2. Maintain all roads for the target vehicles and users. 3. Provide for initial fire suppression access. 4. Maintain a safe transportation system by removing hazards (e.g., hazard trees). 5. Implement Transportation Management Objectives for individual roads. 6. Implement a Transportation Management Plan for the entire area.	High High High High Medium Medium

RESOURCE	OBJECTIVES	RECOMMENDATIONS	PRIORITY
Aquatic Ecosystem	Maintain a transportation system that meets the Aquatic Conservation Strategy and Riparian Reserve objectives.	1. Maintain the transportation system to minimize sediment delivery to streams.	High
		2. Reconstruct, stabilize, reroute, close, obliterate, or decommission roads and skid roads that pose substantial risk to Riparian Reserves. Stabilize, reconstruct, or obliterate landings that pose a risk to Riparian Reserves.	High
		3. Accommodate for 100-year runoff events when installing new stream crossing structures and for existing stream crossing structures that pose substantial risk to Riparian Reserves.	High
		4. Provide accommodations for fish passage at all potential fish-bearing stream crossings and wherever possible, maintain a natural stream bed.	High
		5. Follow the Best Management Practices in the RMP.	High
		6. Evaluate the condition of all roads in Riparian Reserves.	High
Soil Erosion/ Hydrology	Maintain a transportation system that meets the Erosion Processes and Hydrology objectives and recommendations.	1. Reduce road densities in high density areas (Benson, Lightning, and Alexander drainage areas).	High
		2. Maintain road densities in all drainage areas as low as is operationally possible and with a target of less than four miles per square mile. Develop and implement plans for decommissioning/obliterating roads in areas that exceed the target.	High
		3. Survey roads to identify sites where concentrated flow is causing gullying to occur on roads or at drainage outlets. Plan and implement restoration projects with highest priority given to gullies (>6 inches deep), or erosion causing removal of duff layer/surface soil, or down-cut ditches (>6 inches below design ditch bottom).	High
EROSION PROCESSES			
Soil	Minimize erosion that results from management activities.	1. Survey soils with high erosion potential (Map 7), and identify areas of human-caused erosion. Plan and implement projects to eliminate/reduce human-caused erosion. Any new projects should always incorporate erosion control practices (Best Management Practices) where needed.	High
		2. Implement Road Objectives and Recommendations for Soil Erosion.	High

RESOURCE	OBJECTIVES	RECOMMENDATIONS	PRIORITY
SOIL PRODUCTIVITY			
Soil	Maintain and enhance soil productivity within natural ecological levels wherever operationally possible. Address conservation of duff and wood in order to maintain site productivity.	1. Maintain an amount and distribution of coarse woody material that will match healthy stand conditions. This will require surveys of various healthy stands to determine normal levels. Manage for recruitment and long-term maintenance of coarse woody material. (See CWM recommendations under Vegetation- pole, mid- and mature/old-growth condition classes.)	High
		2. Maintain a real extent and thickness of soil duff cover. Enhance soil duff cover in depleted areas (such as areas that have been intensively burned and/or managed) through stand development.	High
		3. Utilize prescribed fire to encourage diversity of vegetation regeneration and decrease risk of depleting soil productivity. Emphasize cool burns that leave a matrix of live vegetation surrounding patches of burned vegetation where pre-existing duff is predominately left in place.	High
		4. Maintain soil compaction levels as low as operationally possible.	High
VEGETATION			
Pole, Mid-, and Mature/Old Growth Condition Classes	Increase growth, quality, and vigor of individual trees. This objective is the most critical for preventing mortality of additional trees.	1. Reduce timber stand densities when the stands have a relative density index of 0.55 or greater by using appropriate silvicultural prescriptions to decrease the number of trees per acre (or basal area) to a relative density index of approximately 0.30 to 0.40. (Refer to Density Management Diagram for Douglas-fir to visualize the concept of relative density and what any particular timber stand may look like at any point of stand development (Appendix C).) This is essential on the south- and west-facing slopes to decrease the occurrence of bark beetle infestations.	High
		2. Manage for species composition by aspect (pine on the south and west slopes, Douglas-fir on the north, etc.).	High
		3. Use pruning as an option for improving wood quality in fast-growing pole stands.	Low

RESOURCE	OBJECTIVES	RECOMMENDATIONS	PRIORITY
Pole, Mid-, and Mature/Old-Growth Condition Classes (Continued)	Design and develop a diverse landscape pattern and contiguous areas of multi-layered, late-successional forest (timber stands with diversified stand structure in regard to tree height, age, diameter classes, and species composition) through uneven-aged management. To meet the NFP retention requirement, no less than 15 percent of BLM forest lands would be in a mature/old-growth condition class at any time. Additional old-growth stands will be present outside of Riparian Reserves and areas of connectivity, most likely as isolated pockets of refugia. The remainder of the forest lands would be in earlier stages of seral development.	1. Prescribe silvicultural treatments that do not dissect contiguous areas of commercial forest stands. 2. Use group selection, single tree selection, irregular uneven-aged and intermediate cutting treatment (thinning and release) methods in combination or singly to create diversified stand structure of varying seral stage development.	High High
	Meet or exceed the 15 percent late-successional retention requirement on federal forest lands to provide habitat to function as refugia for old-growth associated species that have limited dispersal capabilities, such as fungi, lichens, bryophytes, and vascular plants.	1. Identify and maintain all stands that currently meet the retention criteria (multi-storied stands with greater than 21" d.b.h. and greater than 60 percent canopy cover). (Map 23 and Appendix D.) 2. Reserve late-successional stands in all vegetation zones. 3. Spread retained areas evenly over the landscape where possible. 4. Identify and treat target stands for conversion to late-successional or old-growth habitat that will support a more connected network of continuous habitat than currently exists. 5. Treat reserve stands to maintain and create late-successional components, such as canopy cover, snags, and class I and II coarse wood (see Management Objectives and Recommendations, Vegetation, for coarse woody material snags). 6. Prescribe silvicultural treatments aimed at restoring and preserving late-successional pine characteristics in pine associated stands that have been identified for retention, but are overstocked with Douglas-fir and other species.	High High High High High

RESOURCE	OBJECTIVES	RECOMMENDATIONS	PRIORITY
Pole, Mid-, and Mature/Old-Growth Condition Classes (Continued)	Treat pine series stands that have been selected as being mature/old-growth to meet the 15 percent retention requirement as soon as possible to restore pine species as the dominant species.	1. Apply the group selection harvest method to establish pine species regeneration in most cases. 2. Harvest excess Douglas-fir from these stands to allow for desired stand densities and the establishment of pine species regeneration. 3. Create open park-like pine stands over time that have diverse stand structure (many different age classes and canopy layers of pine trees).	High High High
	Create large openings and suitable seedbeds to promote growth of pine species, incense cedar, and Douglas-fir. Increase the species composition of pine species and incense cedar in forest stands where these species are under represented.	1. Use the group selection method to create openings of 0.25 to 2.0 acres. Approximately 5 to 20 percent of the commercial forest lands would receive the group selection method of harvest with a random pattern of group distribution across the landscape. 2. Create favorable seedbed conditions for ponderosa pine through prescribed burning or other methods that would reduce the thickness of the organic horizons, especially around the pine trees. Plant trees in openings to ensure adequate stocking of pine species.	High High
	Assure survival of trees with old-growth characteristics by reducing vegetative competition in second growth timber stands; this preserves genetic material.	1. Reduce competition by removing trees that surround trees with old-growth characteristics. Create an approximate 25-foot crown space between the old-growth tree and the remaining second growth trees. Cut only trees that are not associated (crowns entwined) with the old-growth tree.	High
	Design silvicultural prescriptions to manage dwarf mistletoe infestations.	1. Use selection silvicultural methods to control the rate and intensity of dwarf mistletoe.	High
	Reduce the fire hazard of the timber stands by decreasing the ladder fuels while meeting the needs identified under other resource programs.	1. Decrease the ladder fuels in forest stands by slashing only dense patches of suppressed tree regeneration and shrub species and pruning tree limbs. These treatments should eliminate fire fuels to a height of 6 to 12 feet above ground level. Cut tree limbs that extend into the pruning height area. 2. Form a mosaic of vegetative patterns by leaving untreated patches of vegetation scattered throughout the landscape.	High High

RESOURCE	OBJECTIVES	RECOMMENDATIONS	PRIORITY
Pole, Mid-, and Mature/Old-Growth Condition Classes (Continued)	Maintain the existing areas of knobcone pine to protect the ecological functions of the associated vegetation species.	1. Use prescribed burning in these stands to increase stocking levels of knobcone pine and to reduce plant competition from shrub species.	High
	Retain at least 15 percent of the area in an untreated condition in all project areas distributed throughout the landscape. Untreated areas should be a minimum of 2.5 acres in size and can be in any combination of vegetation condition classes.	1. Use landscape design to maintain designated patches of untreated vegetation in strategic locations (e.g., Riparian Reserves, critical habitat, wildlife corridors, areas between existing tree plantations, shrublands, woodlands, etc.).	High
	Provide for well-distributed coarse woody material (CWM) across the landscape to maintain the ecological functions of the species dependent upon the material. Protect CWM already on the ground from management activities.	1. In regeneration harvest areas, leave a minimum of 120 linear feet of logs per acre greater than or equal to 16 inches in diameter at the large end and 16 feet in length. In partial harvest areas, amounts can be modified to reflect the timing of stand development cycles. Smaller log pieces may be counted when they meet the standards listed in State Office Information Bulletin No. OR-97-064 (11/20/96) (Appendix E). Green trees may also be retained to meet the above requirements. 2. Create an interdisciplinary team to recommend the minimum linear feet of CWM to be retained on a per acre basis for pine series forest. Recommendations should be based on the availability of CWM present and site conditions, such as slope steepness and stand density. 3. Recruit CWM levels that are appropriate for the site (pine series versus Douglas-fir series) gradually over time. It may take 2 to 3 stand entries to acquire desired amounts of CWM especially in regard to large-end log diameter requirements. 4. Perform surveys to determine average amounts of CWM over the landscape for the commercial timber land base and respective vegetation classes. 5. Continue to collect information on biological needs of species/communities to retain appropriate levels of CWM.	High High High High Medium
Early and Seedling/Sapling Condition Classes	Enhance structural diversity of even-aged, single-layer canopy stands.	1. Prescribe commercial thinning treatments at staggered intervals, favoring trees of different heights and species at the time of treatment. 2. Perform release treatments as needed.	Medium Medium

RESOURCE	OBJECTIVES	RECOMMENDATIONS	PRIORITY
Hardwood/ Woodland Condition Class	Maintain or improve the natural functions and processes of the native grass/oak woodlands plant associations where appropriate.	1. Manipulate vegetation species as necessary to maintain the natural functions and processes of the native grass/oak woodland plant associations. 2. Discourage high stocking densities of conifers by using manual treatments and prescribed burning. 3. Manage the abundance of shrub and noxious weed species. 4. Reduce hardwood density to increase water and nutrient availability to the hardwoods for mast production. 5. Use prescribed burning to accomplish recommendations #1-4. 6. Seed native grass species into areas of exposed, disturbed soil before noxious weeds become established.	High High High High High
	Introduce a younger age class into the oak woodlands.	1. Cut suppressed and intermediate crown class trees to induce sprouting. Manage the sprout clumps to favor growth of the dominant sprouts. (After the vigor is restored to the oak trees, acorn crops should provide for more natural regeneration.) 2. Plant oak trees where appropriate.	Medium Low
Shrub Condition Class	Maintain the integrity of the shrublands.	1. Control or eliminate noxious weeds. 2. Concentrate density reduction efforts on the extremely dense shrublands on the south-facing slopes, south of Tallowbox. All shrublands on south-facing slopes should be considered for treatment. In addition, treat the shrublands east of the Applegate River. 3. Manage tree species to maintain the dominance of the desired shrub species. 4. Manage the density and species composition of the shrubs.	High High Medium Medium
Grass Condition Class	Maintain the integrity of the native grasslands.	1. Control or eliminate noxious weeds. 2. Seed native grasses on recently disturbed areas to prevent the establishment of noxious weeds. 3. Treat tree and shrub species to maintain the dominance of native grasses. 4. Develop a native grass propagation program for grasses found in the analysis area.	High High Medium Medium

RESOURCE	OBJECTIVES	RECOMMENDATIONS	PRIORITY
Area burned by the 1987 Star Fire	Modify previously used silvicultural techniques to reforest the burned area.	1. Create 3 to 4 foot radius scalps around planted pine seedlings. The grubbed shrubs should remain in place to provide shade for the soil and organic matter. 2. Plant only pine species at a 12 to 16 foot spacing. 3. Do not put Vexar tubes around the seedlings. 4. Do not plant conifers in the historic shrublands or woodlands.	High High Medium Medium
PLANT SPECIES AND HABITATS			
Special Status Plants	Manage all special status plant species and their habitat so as not to contribute to the need to list as a federally threatened or endangered species.	1. Survey entire analysis area for special status plants. 2. Review all proposed actions for impacts to special status plant habitat. 3. Work with other agencies, colleges, universities, and private groups on conservation strategies. 4. Map plant sites in the analysis area on the Geographic Information System (GIS). 5. Develop and implement conservation strategies for Federal Candidate and Bureau Sensitive species found in the analysis area. 6. Maintain habitat conditions for special status plants, taking into consideration surrounding vegetation needed to maintain 60 percent or greater canopy cover, humidity, temperature, and coarse woody material.	High High High High High High
	Maintain and enhance habitats of special status species found in the analysis area.	1. Control noxious weeds and other exotic species. 2. Use strategy developed to inhibit the spread of and reduce/eliminate noxious weeds.	High Medium
	Preserve, protect, and restore species composition and ecological processes of natural plant communities.	1. Encourage native species use for projects, such as native plant community restoration, erosion control, and wildlife forage enhancement. 2. Avoid the use of native species from nonlocal sources, which may be a threat to local genetic diversity.	High High
	Maintain and enhance rare and special habitats, endemic plant communities, and ecosystems.	1. Develop a sustainable and economical native seed source for future reseeded efforts.	High

RESOURCE	OBJECTIVES	RECOMMENDATIONS	PRIORITY
Survey and Manage Plant Species	Maintain and enhance populations of Survey and Manage species.	1. Implement protocols for Survey and Manage species as they are developed. 2. Maintain patches of late-successional or old-growth forest stands across the landscape for those species that are dependent on this habitat type. 3. Leave trees within harvest units to provide habitat for those species. 4. Maintain the same leave trees over successive rotations. 5. Minimize site disturbance from yarding and heavy equipment. (Removal of humus layer and coarse woody material along with soil compaction may impact populations of fungi and vascular plants.) 6. Maintain interdisciplinary processes when determining harvest levels for special forest products, especially moss, lichen, and fungi collections. 7. Establish research and monitoring on the clustered lady's slipper orchid (<i>Cypripedium fasciculatum</i>).	High High High High High High High
	Control and/or reduce noxious weeds within the analysis area.	1. Reseed areas following ground disturbance to prevent invasion by weed species. Use a native mix when available. 2. Locate and map noxious weed populations within the analysis area. 3. See also Resource "Vegetation", Hardwood/Woodland Condition Class (Recommendations #3 and #6), Shrub Condition Class (Recommendations #3), and Grass Condition Class (Recommendations #2 and #3).	High Medium N/A
	Control and inhibit the future spread of noxious weeds within the analysis area.	1. Reseed areas following ground disturbance. Use a native seed mix when available. 2. Use strategy developed to inhibit the spread of and reduce/eliminate noxious weeds. 3. Locate and prioritize noxious weed populations most susceptible to eradication. Target these populations for treatment(s).	High High Medium

RESOURCE	OBJECTIVES	RECOMMENDATIONS	PRIORITY
FIRE			
Resource Protection	Promote long-term resistance of the area to stand replacement wildfires by reducing the fuel hazard.	1. Treat areas of continuous high hazard fuels in order to help reduce the size and intensity of wildfires. High priority areas would be adjacent to fuel breaks and the rural interface. Treatments should include commercial thinning of overstocked stands and treatment of ground and ladder fuels in both commercial and noncommercial timber lands.	High
		2. Establish fuel breaks along and adjacent to major ridge lines. These fuel breaks would provide a pre-existing defensible area for wildfire suppression efforts. Locate fuel breaks in conjunction with a road system to provide fire suppression access and maintenance. The type of fuel breaks to be constructed would be a combination of shaded fuel breaks and Defensible Fuel Profile Zones (DFPZ).	High
		3. Preclude the establishment of fuel breaks if they would be in conflict with the ROD for the Northwest Forest Plan. They could be precluded if conflicts with other resources arise or there is not the opportunity to treat adjacent fuels in order to make them effective.	High
		Shaded fuel breaks would be located along major ridge lines. Their width would take into account the height of vegetation on and adjacent to the ridge and the steepness of the slope. Widths would range from 150 to 300 feet. Spacing between leave trees would be between 20 to 30 feet in order to allow retardant to penetrate to the forest floor and to minimize the chance of a fire from spreading into the canopy. Ladder and ground fuels would be treated to ensure that fire would stay on the ground and would be of low intensity and of short duration.	

RESOURCE	OBJECTIVES	RECOMMENDATIONS	PRIORITY
Resource Protection (Continued)	Promote long-term resistance of the area to stand replacement wildfires by reducing the fuel hazard. (Continued)	A DFPZ is a strategically located strip or block of land on which fuels have been modified. The objective of these areas is to reduce the potential for a crown fire which in turn, would reduce the intensity and size of a wildfire. These areas are intended to reduce the rate of wind-driven fire and are not intended to stop long range spotting. The canopy within the DFPZ should be no more than 40 percent crown closure and ground fuels should be kept to a minimum. Ladder fuels need to be treated to reduce the probability of a sustained crown fire. To provide for firefighter safety, have only a limited amount of snags for resource requirements. DFPZ's generally are 1/4-mile in width, but would vary depending on topography and fuel types. 4. Develop an overall plan that determines fuel treatment in previously harvested areas to reduce the fuel hazard. As stand improvement projects are implemented, there is the potential for the creation of large continuous acres of high hazard fuel. The plan should also address how many acres in any given time period should be treated in order to minimize the amount of acres that would be in a high fuel hazard condition. 5. Utilize prescribed burning to maintain plant communities, such as the grasslands and oak woodlands. Fire will not only help maintain these communities but also reduce the fuel hazard of these areas.	High High
Safety	Improve firefighter and public safety conditions for future wildfire incidents across the landscape. Safety is being jeopardized because of heavy fuel accumulations.	1. Create a defensible fuel profile zone along major ridge lines. This would provide a safer area for fire suppression personnel to work when fighting wildfire. The treatment of high hazard areas could lower the intensity of future wildfires and thus improve safety conditions for firefighters and residents. 2. Treat high hazard areas around the rural interface areas. Reduce canopy closures and ground and ladder fuels to increase protection of private lands and structures. This should reduce the chance of fire spreading into adjacent resource lands. Treatment of fuels within the rural interface is mostly dependent on factors outside the control of the BLM.	High High

RESOURCE	OBJECTIVES	RECOMMENDATIONS	PRIORITY
TERRESTRIAL WILDLIFE SPECIES AND HABITATS			
Terrestrial Wildlife	Maintain or enhance populations of the terrestrial wildlife species found in the analysis area.	1. Develop and maintain an appropriate quantity and distribution of each seral stage of all plant communities in the analysis area. 2. Maintain adequate snags and coarse down woody material to accommodate those species that are dependent upon these habitat features. 3. Identify and protect special habitats, such as mines/caves, talus, and grassland.	High High High
	Provide Protection Buffers as outlined in the ROD for the Northwest Forest Plan.	1. Great Gray Owl- protect nest sites and meadows greater than 10 acres in size with buffers of 1/4-mile and 300 feet, respectively. 2. Siskiyou Mountains Salamander- provide a horizontal buffer of at least 100 feet or 1 site potential tree around the periphery of known sites. 3. Bats- provide 250-foot buffers around caves, mine adits and shafts, wooden bridges, and old buildings where any of the following species are found: fringed myotis, silver-haired bat, long-eared myotis, long-legged myotis, pallid bat, and Townsend's big-eared bat. 4. For the mollusc species, develop protection measures using Appendix J-2 of the NFP ROD as a guide.	High High High High
	Maintain timbered dispersal corridors on the south- and west-facing slopes of the analysis	1. Protect these dispersal corridors from catastrophic events to the extent reasonably possible.	High

RESOURCE	OBJECTIVES	RECOMMENDATIONS	PRIORITY
HYDROLOGY			
Hydrology	Maintain and enhance in-stream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. Protect the timing, magnitude, duration, and spatial distribution of peak, high, and low flows.	Reduce the potential for altering the timing, magnitude, duration, frequency and spatial distribution of peak flows through the following: 1. Reduce soil compaction by decommissioning or obliterating roads and ripping skid trails. Particular emphasis should be given to areas with high road density (i.e., Upper Star Gulch (above Deadman Gulch), Alstead Gulch, the drainage area between Lightning and Benson Gulch, and Benson Gulch). 2. Allow for 100-year runoff events, including associated bedload and debris, when installing new stream crossing structures and for replacing existing stream crossing structures that pose substantial risk to Riparian Reserves. 3. Manage the transient snow zone for high canopy closure in conjunction with other resource objectives to minimize openings with less than 70 percent canopy cover on north aspects in Douglas-fir stands and 60 percent canopy cover on other than north aspects. 4. Reduce upland fire hazard to minimize potential for catastrophic wildfires. Attempt to increase low flows through the following: 5. Thin overly-dense upland stands to reduce water losses due to interception and transpiration. 6. Discourage spring development or surface/ground water diversions on BLM-managed lands if the development or diversion would not meet the Aquatic Conservation Strategy Objectives. 7. Work with Oregon Water Resources Department to increase in-stream flow water rights in Star Gulch.	High High High High High High Medium
	Monitor baseline information of the effects of management activities on water quantity.	1. Defer Upper Star Gulch Drainage Area from timber harvest and other management activities that would affect the streamflow regime. 2. Continue monitoring baseline water quantity conditions.	High High

RESOURCE	OBJECTIVES	RECOMMENDATIONS	PRIORITY
Hydrology (Continued)	Maintain and enhance the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands (Aquatic Conservation Strategy Objective #7).	1. Avoid wetlands when constructing new roads. 2. Minimize soil compaction due to existing roads or skid trails in meadows and wetlands by decommissioning or obliterating roads and ripping skid trails. 3. Follow interim Riparian Reserve widths identified in the ROD Standards and Guidelines for wetlands greater than one acre. Designate Riparian Reserve widths of 100-foot slope distance from the outer edge of wetlands less than one acre.	High High High
STREAM CHANNEL			
Stream Channel	Maintain and enhance the natural channel stability by allowing streams to develop a stable dimension, pattern, and profile such that, over time, channel features are maintained and the sediment regime under which aquatic ecosystems evolved is maintained or enhanced.	1. Promote growth of conifer trees to reach late-successional characteristics within Riparian Reserves (where capable) for future large woody material recruitment (see Riparian section). 2. Maintain or enhance channel structure to provide high flow energy dissipation. Evaluate and consider opportunities to add energy dissipators, such as large woody debris to streams. 3. Evaluate roads that are adjacent to stream channels and consider decommissioning or obliteration to restore the flood prone area. Obliterate or decommission the road adjacent to Ladybug Gulch. 4. Stabilize eroding stream banks. 5. Reduce stream width-to-depth ratios in appropriate stream reaches, while maintaining a stable dimension, pattern, and profile.	High High High Medium Medium
WATER QUALITY			
Water Quality	Maintain and enhance water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Reducing summer stream temperatures and sedimentation are two principal water quality objectives in the Applegate-Star/Boaz Watershed Analysis Area.	1. Apply appropriate Best Management Practices identified in the Resource Management Plan to minimize soil erosion and water quality degradation during management activities. Reduce summer stream temperatures through the following: 2. Plant or maintain native vegetative species (from local genetic stock) in riparian areas and wetlands to provide adequate stream shading. Highest priority area is along Star Gulch between Ladybug Gulch and Deadman Gulch. 3. Protect riparian vegetation that provides stream shading as specified in the Riparian section.	High High High

RESOURCE	OBJECTIVES	RECOMMENDATIONS	PRIORITY
Water Quality (Continued)	Maintain and enhance water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Reducing summer stream temperatures and sedimentation are two principal water quality objectives in the Applegate-Star/Boaz Watershed Analysis Area. (Continued)	Reduce stream sedimentation through the following: 4. Obliterate, decommission, or upgrade (i.e., improve drainage) roads as necessary to reduce sedimentation and meet transportation management objectives. Highest priorities for road treatments are roads contributing large amounts of sediment to streams and roads in Riparian Reserves, unstable areas, and midslopes.	High
	Monitor baseline information of the effects of management activities on water quality.	1. Defer Upper Star Gulch Drainage Area from timber harvest and other management activities that would affect water quality. 2. Continue monitoring baseline water quality conditions.	High High
RIPARIAN AREAS			
Riparian Reserves	Decrease fragmentation within Riparian Reserves and maintain or enhance connectivity between Riparian Reserves.	1. Follow road recommendations for aquatic ecosystem. 2. Protect tributary junctions (e.g., fluming ditches, discourage thinning and road construction).	High High
	Maintain and enhance the species composition and structural diversity of plant communities in riparian areas and wetlands to provide adequate summer and winter thermal regulation, nutrient filtering, appropriate rates of surface erosion, bank erosion, and channel migration, and to supply amounts and distributions of coarse woody material sufficient to sustain physical complexity and stability. Protect groundwater flow. Protect riparian-dependent special status species (see Botany and Wildlife recommendations).	1. Use the interim Riparian Reserve widths identified in the ROD Standards & Guidelines until a project level, site-specific analysis is performed by an ID Team. 2. Follow the Riparian Reserve module to implement Riparian Reserve boundary changes. 3. Use an interdisciplinary process to design site-specific Riparian Reserve treatments if necessary to maintain or enhance riparian vegetation condition. 4. Use plant stocks from on-site sources. 5. Manage to provide CWM at levels above those assigned to the matrix. 6. Work with local groups to coordinate riparian rehabilitation projects, especially on the Applegate River. 7. Analyze mining impacts within the active channel of Star Gulch and plan channel improvement projects (e.g., redistribute rock) where appropriate.	High High High High High Medium Low

RESOURCE	OBJECTIVES	RECOMMENDATIONS	PRIORITY
Riparian Reserves (Continued)	Maintain and enhance riparian habitat to support well-distributed populations of native plant, invertebrate, and vertebrate riparian-dependent species, especially taking into consideration long-term plant community changes.	In addition to the above recommendations: 1. Protect untouched Riparian Reserve areas (e.g., late-successional/old-growth) in the Star Gulch Watershed; silvicultural management would not occur until old clearcut areas have recovered. 2. Discourage spring developments that do not meet the Aquatic Conservation Strategy Objectives.	High Medium
AQUATIC WILDLIFE SPECIES AND HABITATS			
Aquatic Wildlife	Ensure that management activities in the analysis area do not lead to listing of special status species.	1. Monitor impacts of management activities on special status populations and aquatic habitat. 2. Coordinate habitat and population monitoring with Oregon Department of Fish and Wildlife, U.S. Forest Service, and Applegate River Watershed Council.	High High
	Maintain or enhance aquatic wildlife populations, their distribution, habitat, and long-term sustainability.	1. Identify and map habitat areas needed for different life stages (i.e., spawning, rearing, etc.) of aquatic species. 2. Protect special habitat areas (i.e., small wetlands, springs, etc.) used by specialized aquatic wildlife species. 3. Maintain fish ladder at the mouth of Star Gulch in cooperation with State and federal agencies and private groups. 4. Repair old log structures in Star Gulch. 5. Increase pool: riffle ratio in Star Gulch by adding LWD > 24" in diameter. 6. Follow recommendations outlined in Hydrology and Soils sections. 7. Educate both "in-house" and local groups how to prevent further degradation of aquatic habitat. 8. Work with local groups to coordinate stream improvements on federal and private lands, especially along the Applegate River.	High High High High High High High Medium

RESOURCE	OBJECTIVES	RECOMMENDATIONS	PRIORITY
Aquatic Wildlife (Continued)	Maintain or enhance aquatic wildlife populations, their distribution, habitat, and long-term sustainability. (Continued)	9. Work with local, State, and federal groups to manage water diversions to restore or maintain sediment routing, fish passage at low flow, and screen juvenile fish out of irrigation ditches.	Medium
		10. Work with the Army Corps of Engineers, local, State, and federal groups to develop a plan to mimic natural floods as much as possible while protecting private land and residences, in order to maintain fish habitat, especially spawning gravels and coho rearing areas.	Low

LANDSCAPE PLANNING OBJECTIVES AND RECOMMENDATIONS FOR FEDERAL LANDS

The landscape of the Applegate-Star/Boaz Watershed Analysis Area is a complex web of interacting ecosystems; recognizing this, the watershed analysis team melded individual resource information to develop a landscape plan for federal lands. The team examined the current condition of the terrestrial and aquatic components of the landscape and synthesized the information to develop landscape level objectives and recommendations. Map 24 shows federal lands across the landscape that need special consideration prior to project planning.

LANDSCAPE AREA	OBJECTIVES	RECOMMENDATIONS
Riparian Reserves	Maintain and enhance the species composition and structural diversity of plant communities in riparian areas and wetlands to provide adequate summer and winter thermal regulation, nutrient filtering, appropriate rates of surface erosion, bank erosion, and channel migration, and to supply amounts and distributions of large woody debris (LWD) sufficient to sustain physical complexity and stability.	1. Use the interim Riparian Reserve widths identified in the ROD Standards & Guidelines until a project level, site-specific analysis is performed by an interdisciplinary team. 2. Follow the Riparian Reserve module to implement Riparian Reserve boundary changes. 3. Use an interdisciplinary process to design site-specific Riparian Reserve treatments if necessary to maintain or enhance riparian vegetation condition. 4. Use plant stocks from on-site sources. 5. Manage to provide LWD at levels above those assigned to the matrix. 6. Work with local groups to coordinate riparian rehabilitation projects, especially on the Applegate River. 7. Analyze mining impacts within the active channel of Star Gulch and plan channel improvement projects (e.g., redistribute rock) where appropriate.
	Maintain and enhance riparian habitat to support well-distributed populations of native plant, invertebrate, and vertebrate riparian-dependent species, especially taking into consideration long-term plant community changes.	1. Protect untouched Riparian Reserve areas (e.g., late successional/old-growth) in the analysis area by not allowing silvicultural management until old clearcut areas have recovered. 2. Discourage spring developments that do not meet the Aquatic Conservation Strategy.
	Decrease fragmentation within Riparian Reserves, and/or maintain or enhance connectivity between Riparian Reserves.	1. Reroute, obliterate, and/or rehabilitate roads, skid trails, and landings within Riparian Reserves where possible. 2. Protect tributary junctions (e.g. fluming ditches, discourage thinning and road construction)..

LANDSCAPE AREA	OBJECTIVES	RECOMMENDATIONS
15 Percent Late-Successional Retention Areas	Meet or exceed the 15 percent late-successional retention requirement on federal forest lands to provide habitat to function as refugia for old-growth associated species that have limited dispersal capabilities, such as fungi, lichens, bryophytes, and vascular plants.	1. Identify and maintain all stands that currently meet the retention criteria (multi-storied stands with greater than 21" d.b.h. and greater than 60 percent canopy cover). (Map 23 and Appendix D.) 2. Reserve late-successional stands in all vegetation zones. 3. Spread retained areas evenly over the landscape where possible. 4. Identify and treat target stands for conversion to late-successional or old-growth habitat that will support a more connected network of continuous habitat than currently exists. 5. Treat reserve stands to maintain and create late-successional components, such as canopy cover, snags, and class I and II coarse wood (see Management Objectives and Recommendations, Vegetation, for coarse woody material amounts). 6. Proscribe silvicultural treatments aimed at restoring and preserving late-successional pine characteristics in pine associated stands that have been identified for retention, but are overstocked with Douglas-fir and other species.
Northern Spotted Owl Activity Centers	Retain and/or manage for late-successional characteristics within the known spotted owl activity centers.	1. Manage the surrounding landscape to protect the activity centers from catastrophic events. 2. If management is needed, ensure that silvicultural methods prevents attainment of late-successional characteristics.
Old-Growth Refugia	Provide habitat to function as refugia for old-growth associated species that have limited dispersal capabilities, such as fungi, lichens, bryophytes, and vascular plants.	1. Retain remnant old-growth patches across the landscape. 2. Use a variety of silviculture methods to create the desired characteristics for late-successional forest where these stands do not occur. 3. Within all harvest areas, maintain amounts of coarse woody material (CWM) that are representative of the natural conditions.
Wildlife Corridors	Retain critical, forested wildlife corridors on drainages with south/west aspects. Retain or create wildlife corridors between the Applegate-Star/Boaz Watershed Analysis Area and surrounding watersheds.	1. Designate selected drainages as important wildlife corridors (Map 24). 2. Manage the adjacent landscape to protect corridors from natural disturbances (e.g., fire and wind). 3. Treat all vegetation condition classes surrounding the corridors to reduce the fire hazard rating, thus protecting the timber stands. 4. Use appropriate silvicultural prescriptions to maintain forested timber stands within and between adjacent watersheds. Prescriptions will maintain stands in the mature stem exclusion to the understory regeneration stages of stand structure.

LANDSCAPE AREA	OBJECTIVES	RECOMMENDATIONS
Terrestrial Vegetation	Develop commercial forest stands with late-successional characteristics in areas that predominantly had these traits. Create late-successional stands between drainage areas where appropriate.	1. Assure that recommended silvicultural prescriptions maintain contiguous areas of late-successional forest. 2. Use a variety of silvicultural methods to create the desired characteristics for late-successional forests within these areas.
	Treat all vegetation condition classes in strategic locations, especially commercial forest stands, to ensure their survival from insects and fire and enhance seral and structural development of the condition classes.	1. Develop prescriptions that reduce fire hazard and improve vegetative health to protect natural resources or sites of cultural value from biotic disturbances (fire and wind). 2. Manage vegetative density of all vegetation condition classes. 3. Use selection silvicultural harvest methods to create or enhance the development of late-successional forests. 4. Manage pine series forest in the commercial base for an open park-like structure. 5. Target Douglas-fir stands adjacent to shrublands or woodlands on south and west slopes or on ridges that receive sunlight for most of the day for density management. The land north of Star Gulch Road has most of the stands that meet this criteria. 6. The shrublands south of Tailorbox Lookout are in need of density and species management as well as the shrublands east of the Applegate River.
High Fire Hazard Areas	Promote long-term resistance of the area to stand replacement wildfires by reducing the fuel hazard.	1. Establish fuel breaks along and adjacent to major ridgelines. These fuel breaks would provide a pre-existing defensible area for wildfire suppression efforts. Locate fuel breaks in conjunction with a road system to provide fire suppression access and maintenance. The type of fuel breaks that would be constructed would be a combination of shaded fuel breaks and Defensible Fuel Profile Zones (DFPZ). (The establishment of fuel breaks would be precluded if they would be in conflict with the ROD for the Northwest Forest Plan. They could be precluded if conflicts with other resources arise or there is not the opportunity to treat adjacent fuels in order to make them effective.)
Upper Star Gulch Monitoring Area	Provide baseline information of the effects of management activities on water quality and quantity.	1. Defer Upper Star Gulch Drainage Area from timber harvest and other management activities that would affect water quality and quantity. 2. Continue monitoring baseline water quality and quantity conditions.
Transient Snow Zone	Reduce the potential for altering the timing, magnitude, duration, frequency and spatial distribution of peak flows.	1. Manage the transient snow zone for high canopy closure in conjunction with other resource objectives to minimize opening with less than 70 percent canopy cover on north aspects in Douglas-fir stands and 60 percent canopy cover on other than north aspects.

LANDSCAPE AREA	OBJECTIVES	RECOMMENDATIONS
Roads of Concern	Reduce road density and road-caused erosion, stabilize roads that are unstable, and reduce road-caused wildlife harassment.	1. Follow recommendations for roads of concern in Appendix F.

DATA GAPS

This section identifies information that was not available for the analysis. Items under each ecosystem element are listed in priority order. Missing information will be acquired as funding permits.

Human Uses

Archaeological Sites

1. Systematic archaeological survey.
2. Formal evaluation of known historic sites.

Unauthorized Use

1. Property lines in locations where unauthorized use is suspected.

Grazing

1. Economic contribution of livestock operations to local communities.

Roads

1. Road condition surveys.
2. Transportation management plan.
3. Updated transportation management objectives.
4. Updated maintenance operation plan.

Soils

1. Duff thickness in various vegetative types.
2. Ravel movement rates in varying surface conditions.
3. Extent of soil productivity reduction caused by intense fire and/or fire related salvage logging.
4. Location of erosion sites.
5. Erosion rates resulting from management actions.
6. Disturbance affects on long-term soil productivity.

Vegetation

1. Comprehensive data on drought resistance for tree and shrub species.
2. Soil carbon/nitrogen ratios.
3. Available trace elements in the soil and trace element requirements of tree species.
4. More statistical data regarding the historical range, frequency, and distribution of

vegetation species over the landscape.

Plant Species and Habitats

Special Status Plant Species

1. Inventory of special status plants.
2. Inventory of non-native plant species (especially noxious weeds).
3. Population data on special status plants (includes range, distribution, and frequency).

Survey and Manage Plant Species

1. Inventory for survey and manage species (fungi, bryophytes, and lichens).
2. Role of fungal species, bryophytes, and lichens in the ecosystem.

Fire

1. Exact acreage and location of existing and past high hazard, medium hazard, and low hazard areas.
2. Data regarding the range, frequency, distribution, and interaction of insects, animals, vegetation and fire intensities.
3. Wildfire intensities and consumption rates over the landscape during differing climatic conditions through time.
4. Cultural understanding of fire use during prehistoric times.
5. Complete fire start information (e.g., location, cause, time) prior to 1969.
6. Classification of land by plant association within and outside fire regimes.

Terrestrial Wildlife Species and Habitats

1. Existing and desired abundance, patch size, and distribution of the condition classes found in the analysis area.
2. Distribution and population trend data for those species found in the analysis area.
3. Snag and coarse woody material abundance by condition class.

Hydrology

1. Stream categories for nonfish-bearing streams (permanently flowing or intermittent).
2. 1997 New Year's Day flood data.
3. Soil compaction analysis for Applegate frontal drainage areas.
4. On-the-ground wetland inventory.

Stream Channel

1. Sediment source locations.
2. Field verification of stream classification
3. Field verification of stream substrate materials.

- 4. Stream channel stability and condition.**
- 5. Post-1997 New Year's Day flood channel conditions.**

Water Quality

- 1. Water quality data for Star Gulch and tributaries (sediment, nutrients, and bacteria).**
- 2. Water quality data for Applegate River and frontal drainages (turbidity, sediment, dissolved oxygen, pH, nutrients, and bacteria).**

Riparian Areas

- 1. Riparian condition.**
- 2. Riparian and in-stream surveys to determine:**
 - a. Amount of large woody debris;**
 - b. Amount, diversity and age of riparian vegetation, including percent of shading; and**
 - c. Stream geomorphology, including pool/riffle ratios, pool depth, and substrate composition.**

Aquatic Wildlife Species and Habitats

- 1. Aquatic insects inventory.**
- 2. Upstream distribution and relative abundance of all native fish species.**
- 3. Spawning escapement of coho and steelhead.**
- 4. Habitat requirements of non-salmonid native fish species.**
- 5. Impacts of introduced fish on native species.**
- 6. Distribution and relative abundance of non-salmonid species.**
- 7. Number of Applegate River-produced anadromous fish harvested in the ocean and Rogue River.**

MONITORING

The following monitoring recommendations are made in order to gain a better understanding of the watershed processes and conditions within the Applegate-Star/Boaz Watershed. Items under each ecosystem element are listed in priority order.

Human Uses

Mining

1. Monitor all mining claim activities on-the-ground for compliance with the regulations.

Soils

1. Monitor erosion features resulting from road construction.
2. Monitor gravel surface movement on steep slopes.
3. Monitor newly compacted areas through contract administration.
4. Monitor duff thickness. Prior to and after surface disturbing projects, various vegetation types in the analysis area should surveyed, measured, and compare duff thickness. Suggested standard is > 90 percent thickness over 90 percent or more of forest project sites.

Vegetation

1. Monitor commercial timber stands for vigor by using relative density as an index.
2. Measure individual tree growth in commercial timber stands.
3. Analyze crown closure/canopy closure before and after vegetation treatment.
4. Monitor amounts of coarse woody material before and after timber harvesting operations.
5. Monitor the number and quality of snags (and perhaps how the trees were killed; insects or pathogens) and suitability of cavity formation.
6. Monitor acorn crops after oak woodland treatments.
7. Monitor the survival of individual pine trees after release treatments.

Plant Species and Habitats

Special Status Plants

1. Monitor plant population's response to disturbance.
2. Monitor environmental effects on special status plants.

Survey and Manage Species

1. Monitor species response to disturbance.
2. Monitor environmental effects on survey and manage species.

Fire

1. Monitor changes in hazard ratings after treating all the vegetation condition classes.

Terrestrial Wildlife Species and Habitats

1. Monitor site occupancy, reproductive status, and reproductive success of threatened/endangered species found in the analysis area.
2. Monitor population trend of the special status survey and manage and other priority species found in the analysis area.
3. Monitor rate of recruitment/loss of snags and coarse woody material.
4. Monitor rate of seral stage change in the vegetative communities found in the analysis area.

Hydrology

1. Monitor changes in road density and soil compaction.
2. Monitor changes in canopy closure of the transient snow zone.
3. Monitor changes in streamflow as watershed conditions change.

Stream Channel

1. Monitor changes in stream classification.
2. Monitor changes in channel stability and condition.
3. Monitor changes in channel dimension, pattern, and profile.

Water Quality

1. Continue monitoring stream temperatures and turbidity in Star Gulch and its tributaries.
2. Monitor dissolved oxygen and pH on a regular basis at temperature sites.
3. Monitor sediment, nutrients, and bacteria at selected sites.

Riparian Areas

1. Monitor riparian habitat (i.e., large woody debris, shading, microclimate) before and after implementing management prescriptions.

Aquatic Wildlife Species and Habitats

1. Monitor summer steelhead spawning activity in Star Gulch.
2. Continue to monitor selected Star Gulch sites for macroinvertebrates.
3. Request that Oregon Department of Fish and Wildlife monitor coho spawning in the Applegate River.
4. Monitor non-salmonid native fish populations and introduced fish populations.
5. Monitor fish habitat.

RESEARCH

The following research recommendations would provide additional understanding of ecosystem processes in the Applegate-Star/Boaz Watershed. Items under each ecosystem element are listed in priority order.

Soils

1. Determine comprehensive data on percent duff (cover and thickness), coarse woody material (size and distribution) and relationships to beneficial soil organisms.
2. Study natural erosional processes versus human aggravated erosional problems to determine extent of site productivity loss.
3. Obtain more comprehensive mapping data on bedrock geology and associated field studies.
4. Study rates of ravel movement for various surface conditions.
5. Study the extent of soil productivity reduction caused by intense fire and related salvage logging (Star Fire).

Vegetation

1. Determine the evapotranspiration rates for all endemic tree and shrub species (in inches of water).
2. Determine how many old-growth trees are needed on a per acre basis to maintain ecosystem functions of late-successional forests.
3. Determine coarse woody material requirements for maintaining site productivity.
4. Determine stocking levels of oak species that are optimum for producing acorn crops. (The amount of nutrient inputs into the oak woodlands induced by prescribed burning may also be critical.)
5. Develop methods of controlling noxious weeds.
6. Conduct comprehensive studies on the ecological requirements of Oregon white and California black oak to produce acorn crops, including optimum tree density (stems/acre), impact of competing vegetation (how much can grow around the oaks?), and the occurrence, frequency, and intensity of fires needed to return nutrients to the soil.
7. Determine the length of time that trees can live in low elevation or on droughty Applegate sites.

Plant Species and Habitats

Special Status Plants

1. Obtain population biology data (includes information on life history, life cycle, limiting factors, seed dispersal and seed dispersal corridors, pollinators, dormancy, recruitment, seed bank, interaction between and within species, mortality, predation pathogens, and genetic diversity).

2. Determine ecological requirements (includes species composition changes over time and under different successional stages, relationships among species, associations, affects of biotic and abiotic factors, distance and effectiveness of dispersal, specific habitat requirements, nutrient dynamics, food chains, diversity between populations, etc.).
3. Determine demographic data (includes population structure, number, size, reproductive condition, distribution, and trend).

Survey and Manage Species

See Special Status Plants for the two vascular survey and manage species (*Cypripedium fasciculatum* and *C. montanum*).

Terrestrial Wildlife Species and Habitats

1. Use the MAXMIN approach, as described by Raphael (1991), to determine the optimum mix of age classes/seral stages of the vegetative communities found in the analysis area to maximize the probability of viability of all indigenous species.

Hydrology

1. Determine the change in streamflows resulting from density management treatments.

Stream Channel

1. Determine amounts of large woody material needed in steep headwater channels.

Water Quality

1. Determine potential for Star Gulch to exceed state temperature criterion even with riparian canopy providing full shade to stream.

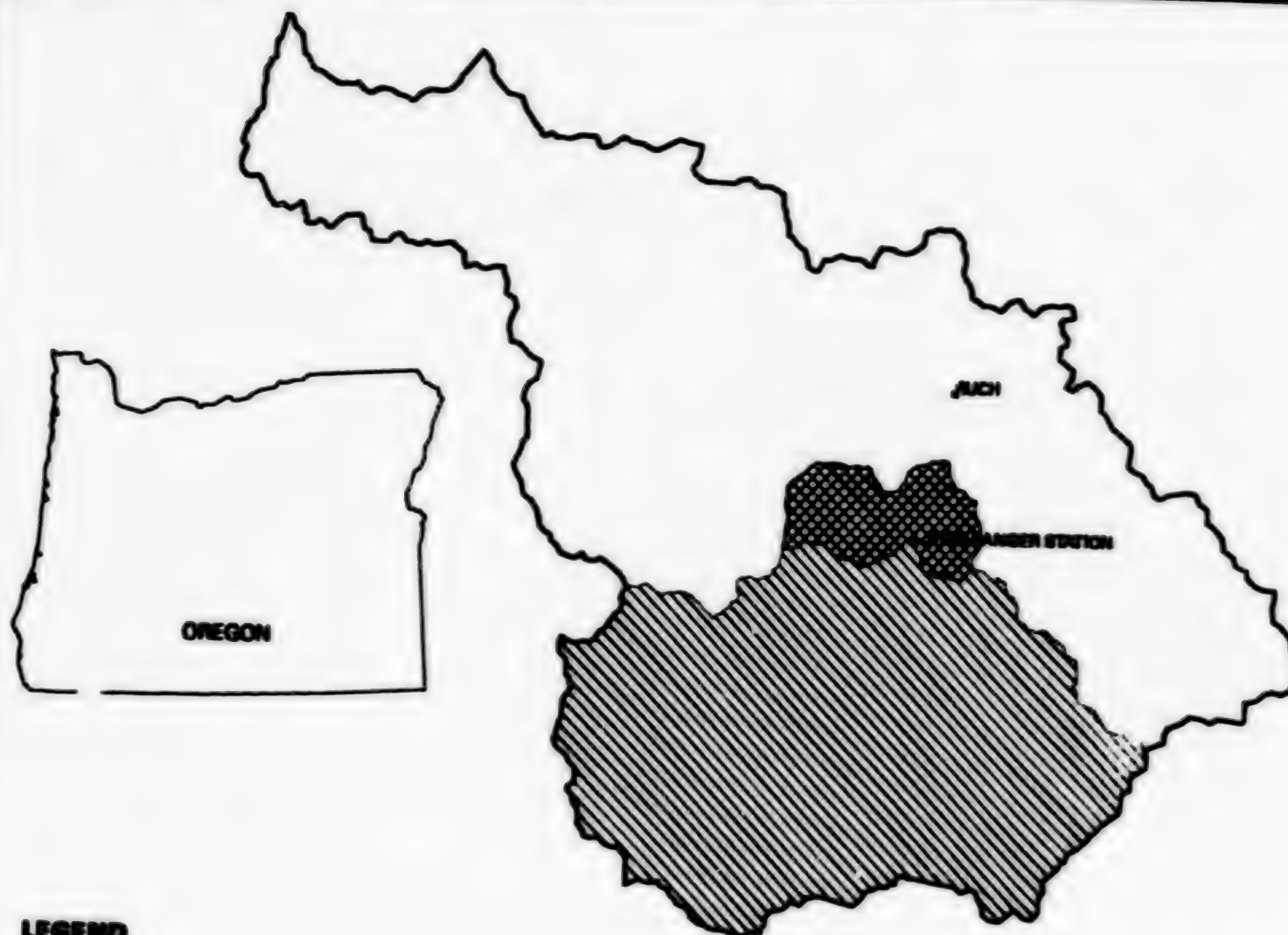
Riparian Areas

1. Determine the function and ecological importance of riparian systems along intermittent and ephemeral stream.
2. Determine difference in riparian plant communities between north-facing and south-facing streams.

Aquatic Wildlife Species and Habitats

1. Request that ODFW research the impacts of introduced fish on resident fish populations in the Applegate River.
2. Determine impact of flow alteration from the Applegate Dam and water withdrawals on native fish habitat.

MAPS



January 10, 1997

L. Smith

SCALE 1:443520

1" = 7 miles

OREGON

RICH

DANGER STATION

LEGEND

- APPLEGATE SUBBASIN
- ▨ UPPER APPLEGATE WATERSHED
- ▧ STAR/BOAZ WATERSHED ANALYSIS AREA

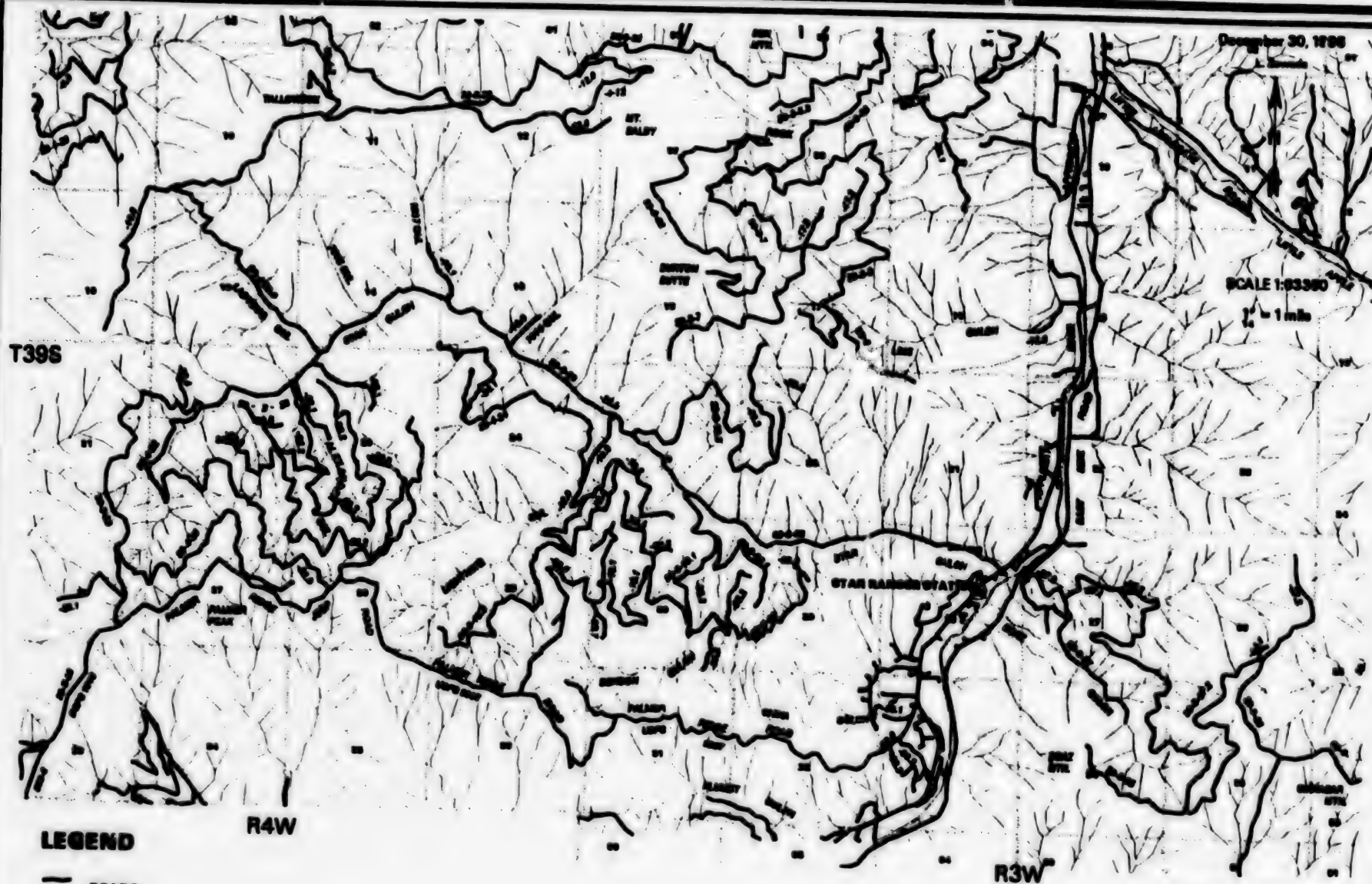
Applegate-Star/Boaz Watershed Analysis Area
Applegate River Subbasin



MAP 1

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PAGE



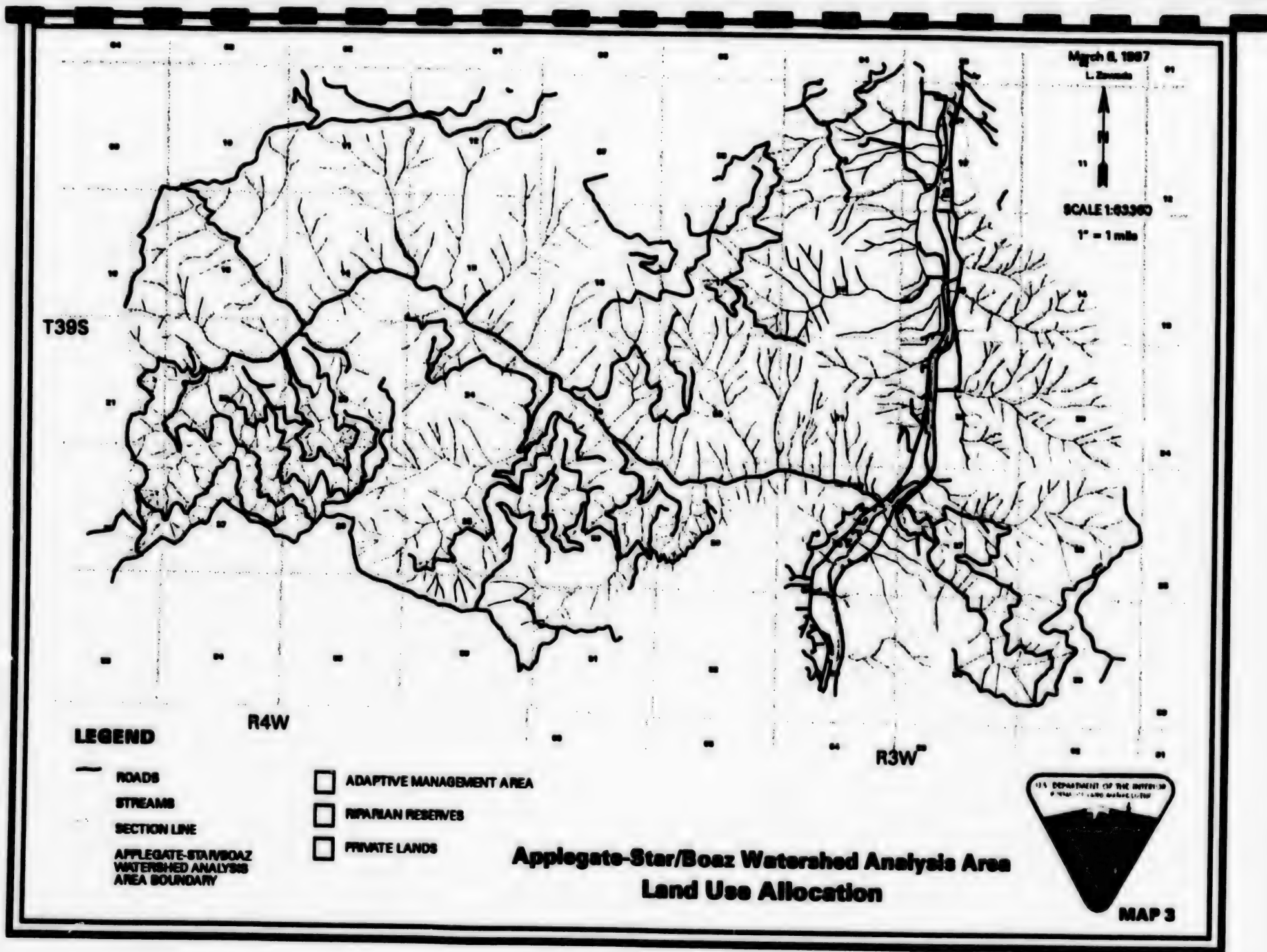
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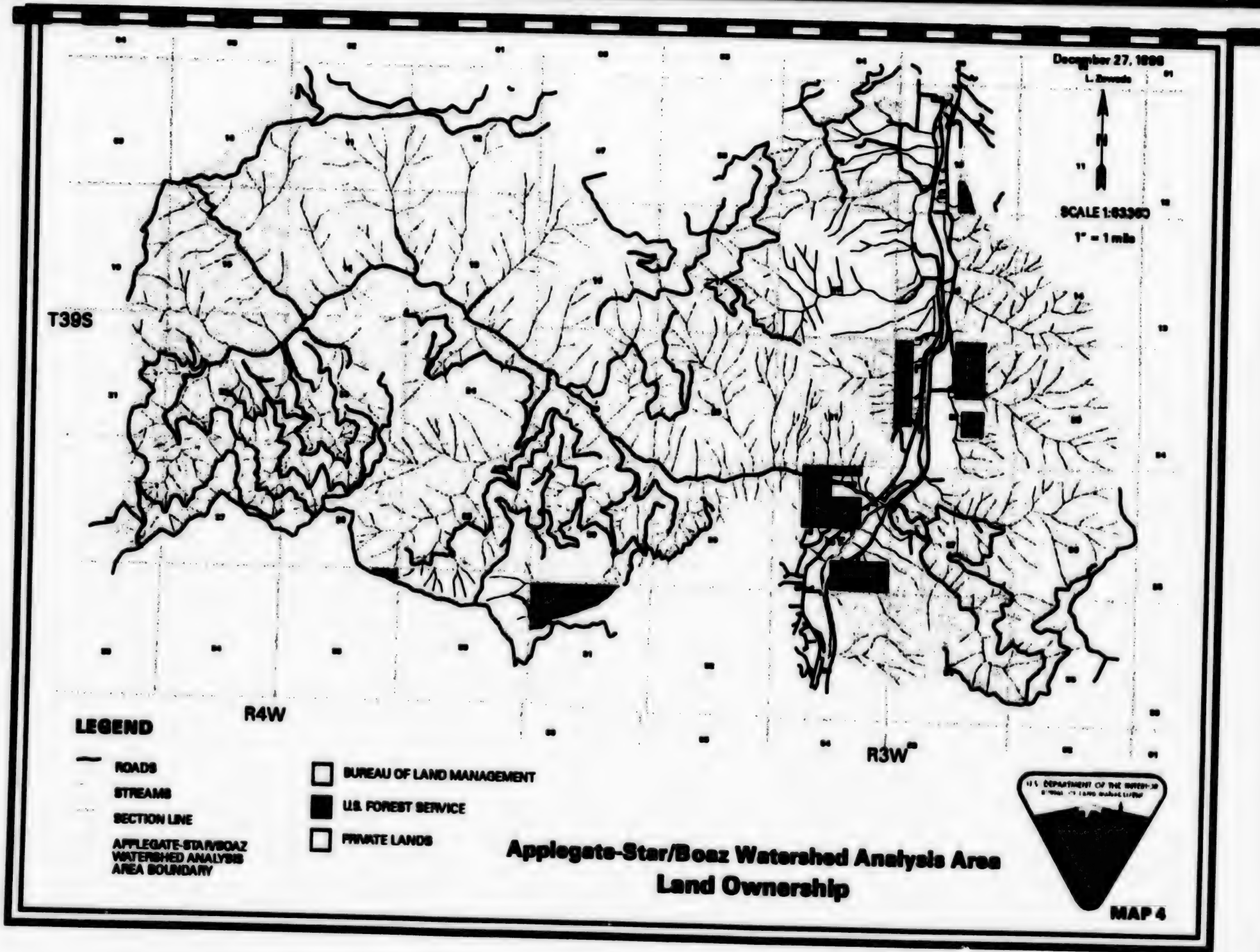
- ROADS
- STREAMS
- SECTION LINE
- APPLGATE-STAR/BOAZ WATERSHED ANALYSIS AREA

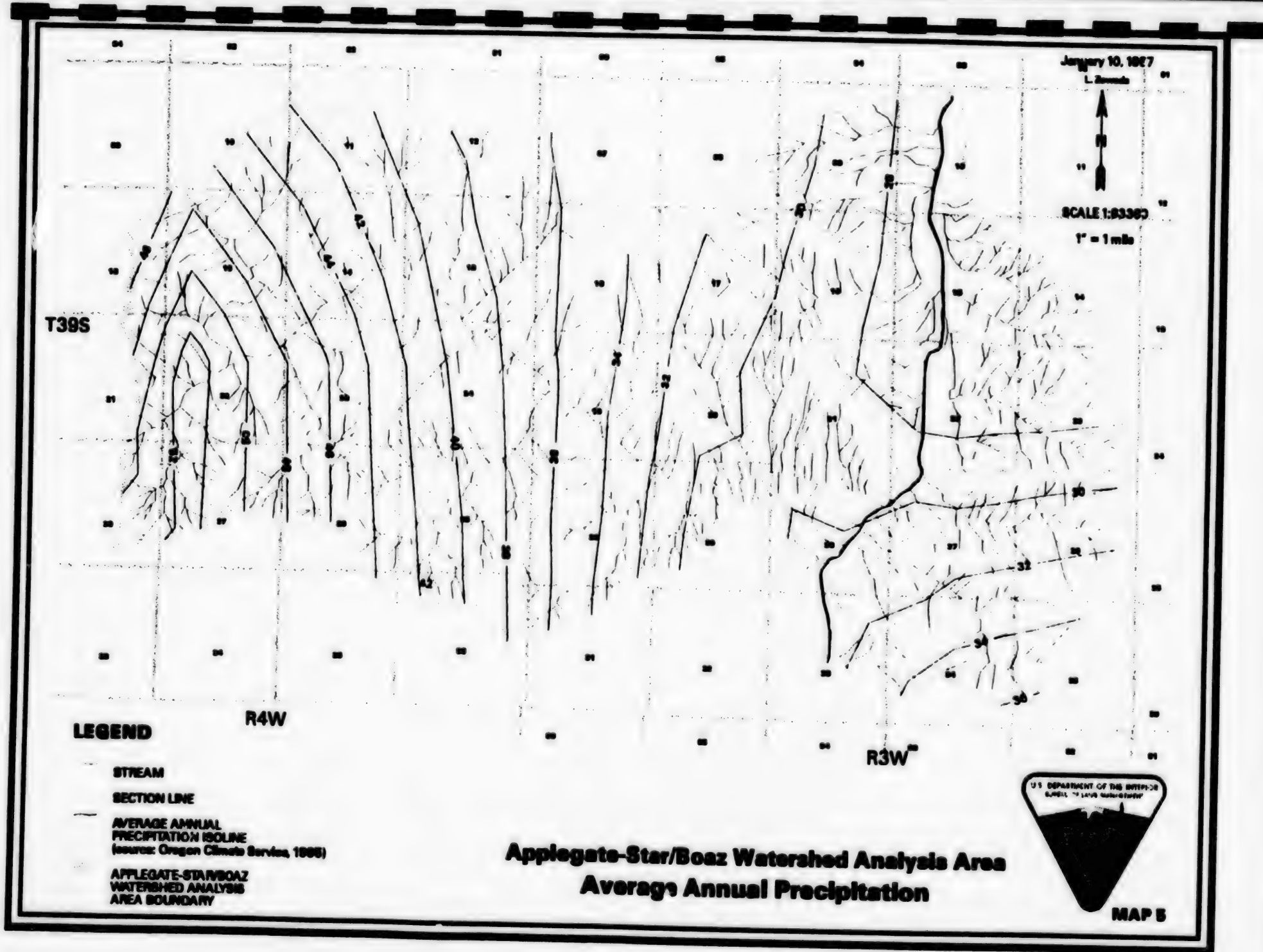
Applegate-Star/Boaz Watershed Analysis Area
Applegate-Star/Boaz Watershed Analysis Area

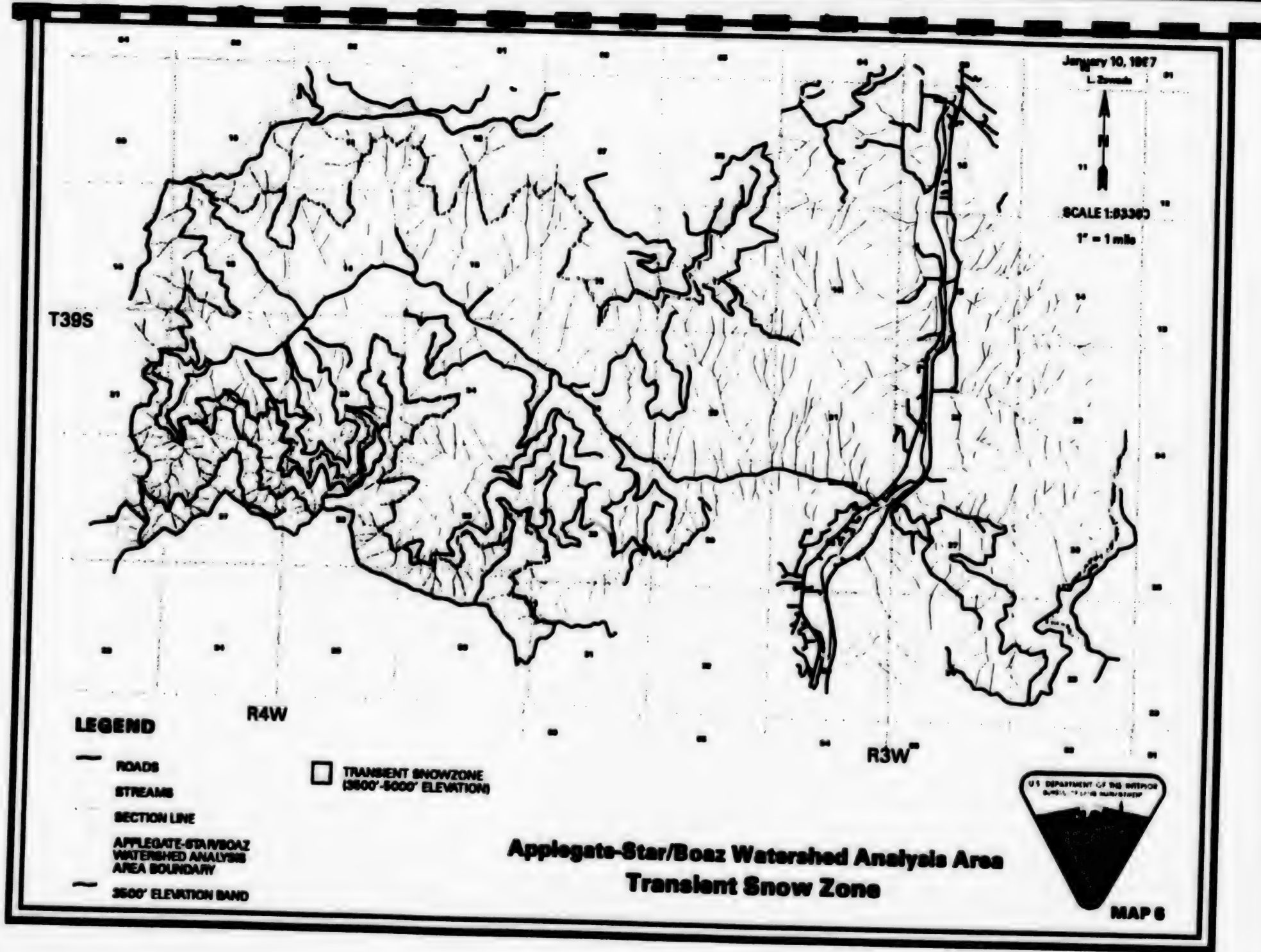


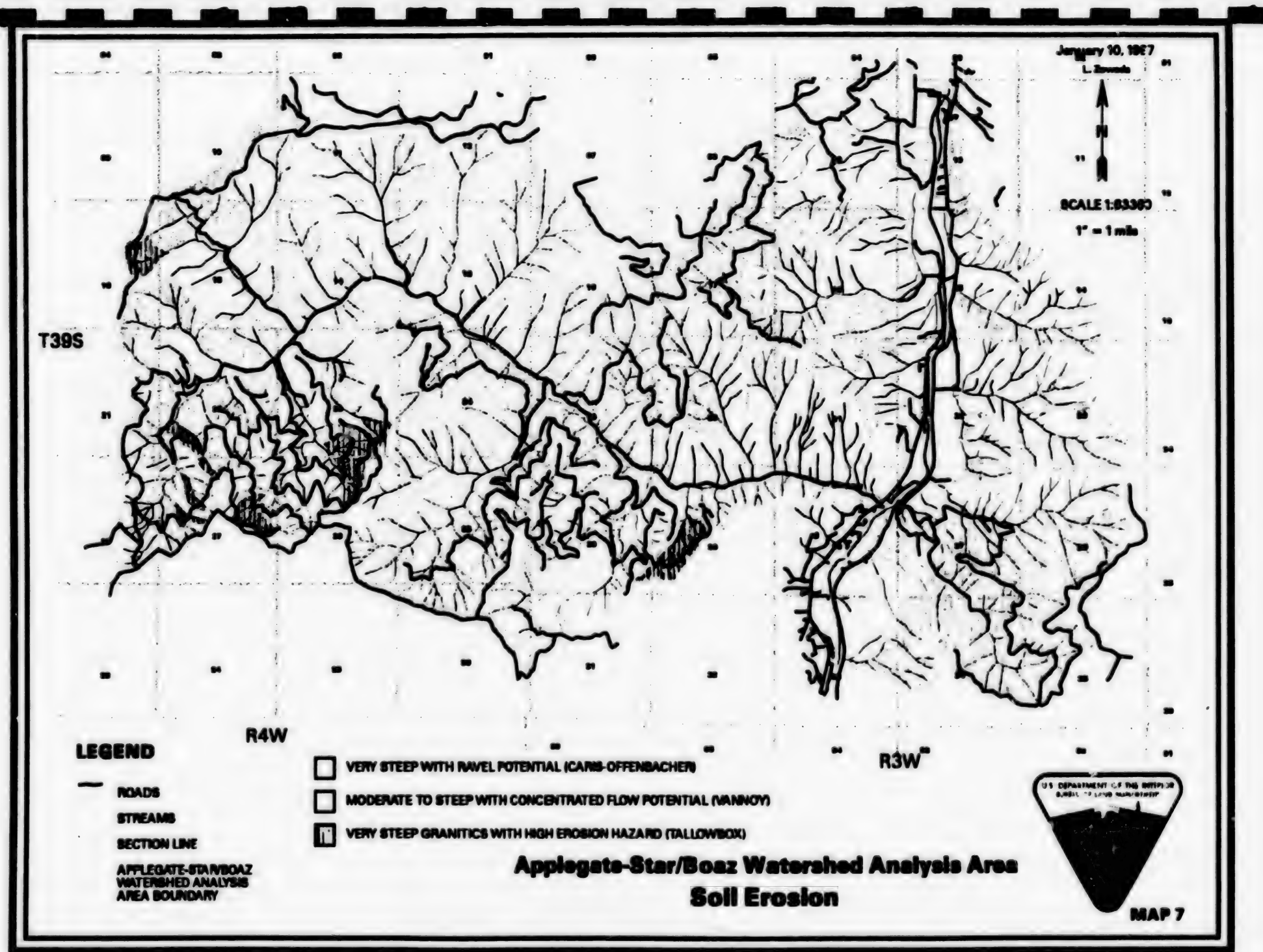
MAP 2











January 10, 1987

L. Swends

SCALE 1:83360

1" = 1 mile

T39S

R3W

LEGEND

ROADS

STREAMS

SECTION LINE

APPLIGATE-STAR/BOAZ
WATERSHED ANALYSIS
AREA BOUNDARY

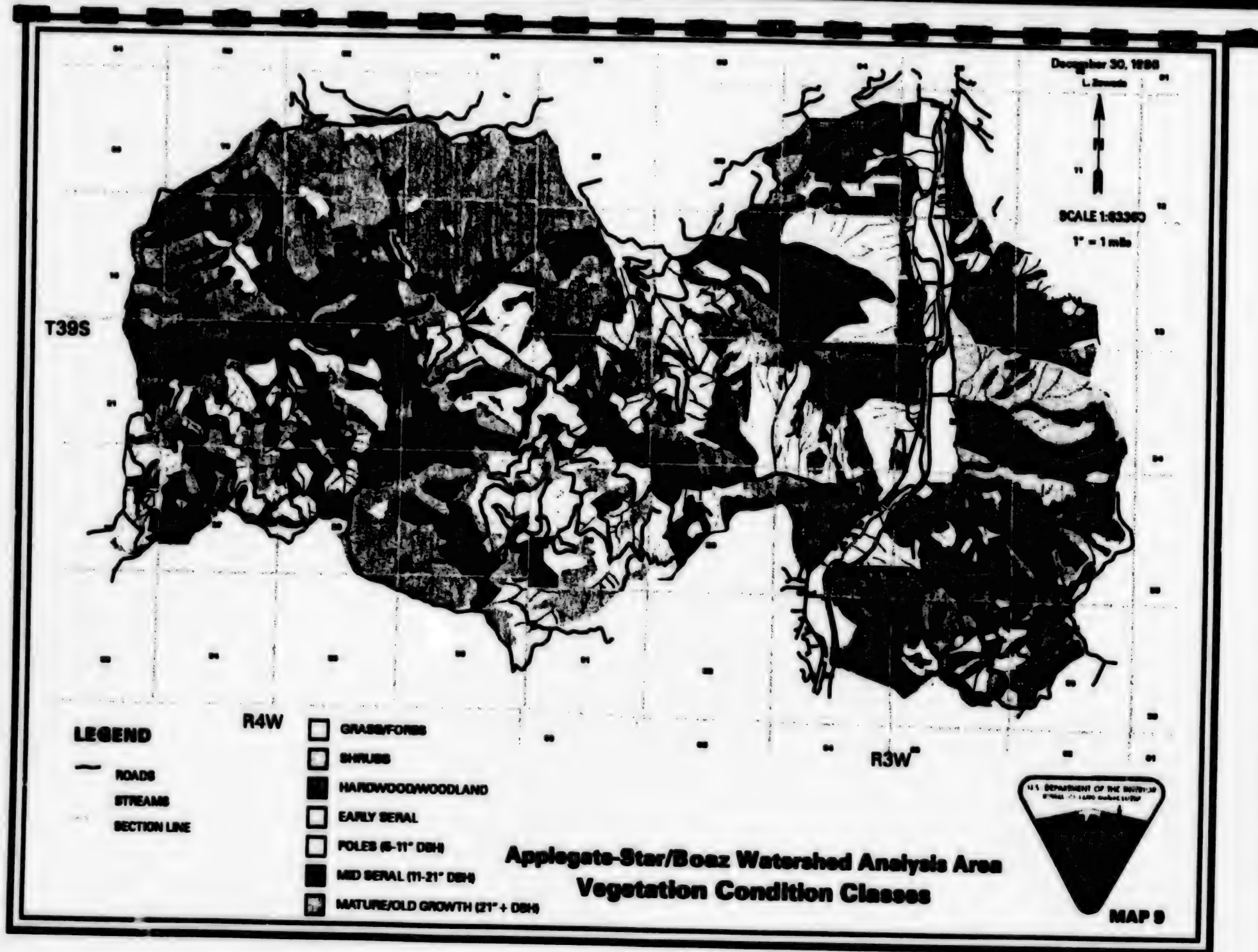
R4W

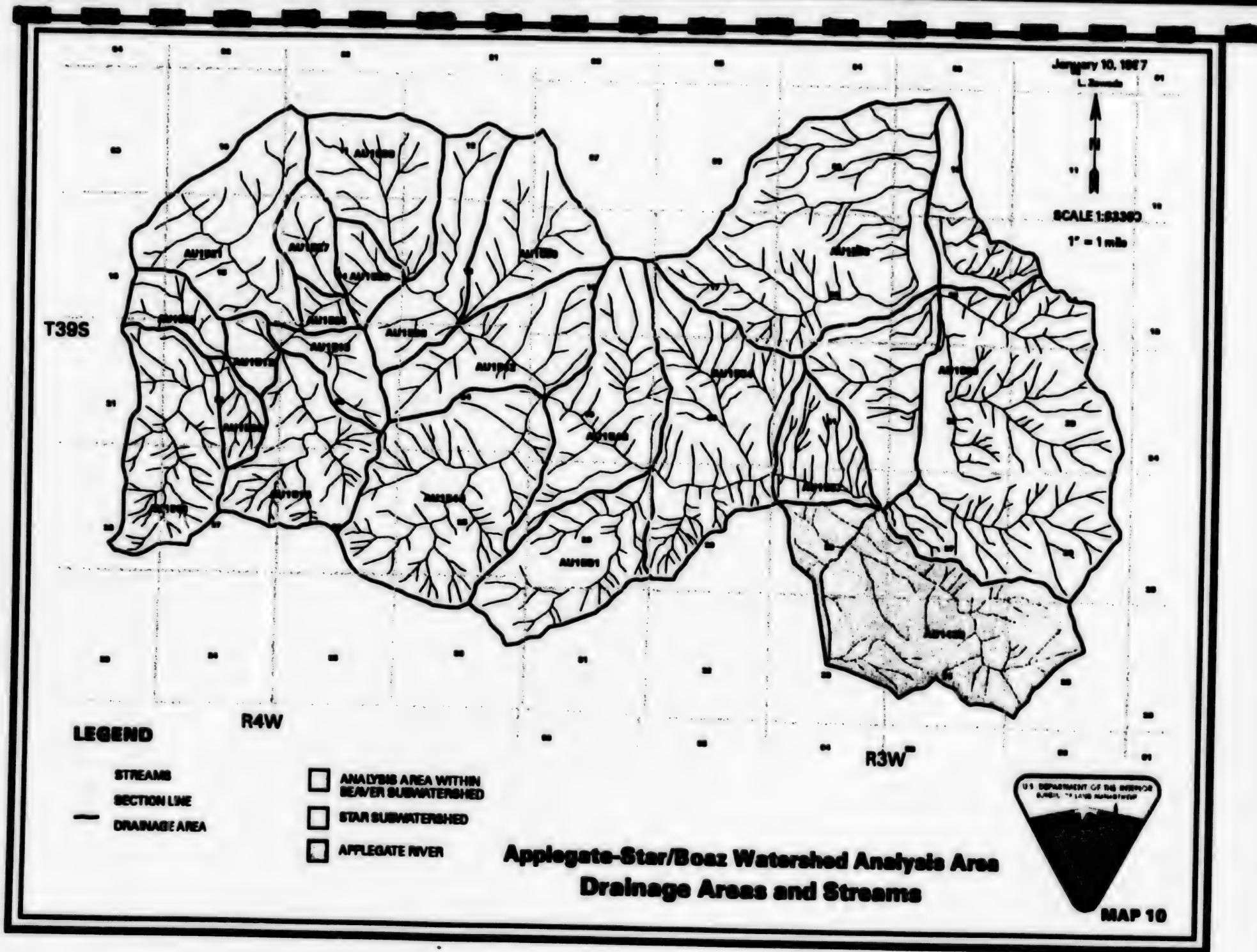
- ☐ VERY LOW
- ☒ LOW
- ☐ MEDIUM
- ☐ HIGH
- ☐ NONFOREST
- ☐ AGRICULTURAL
- ☐ UNKNOWN

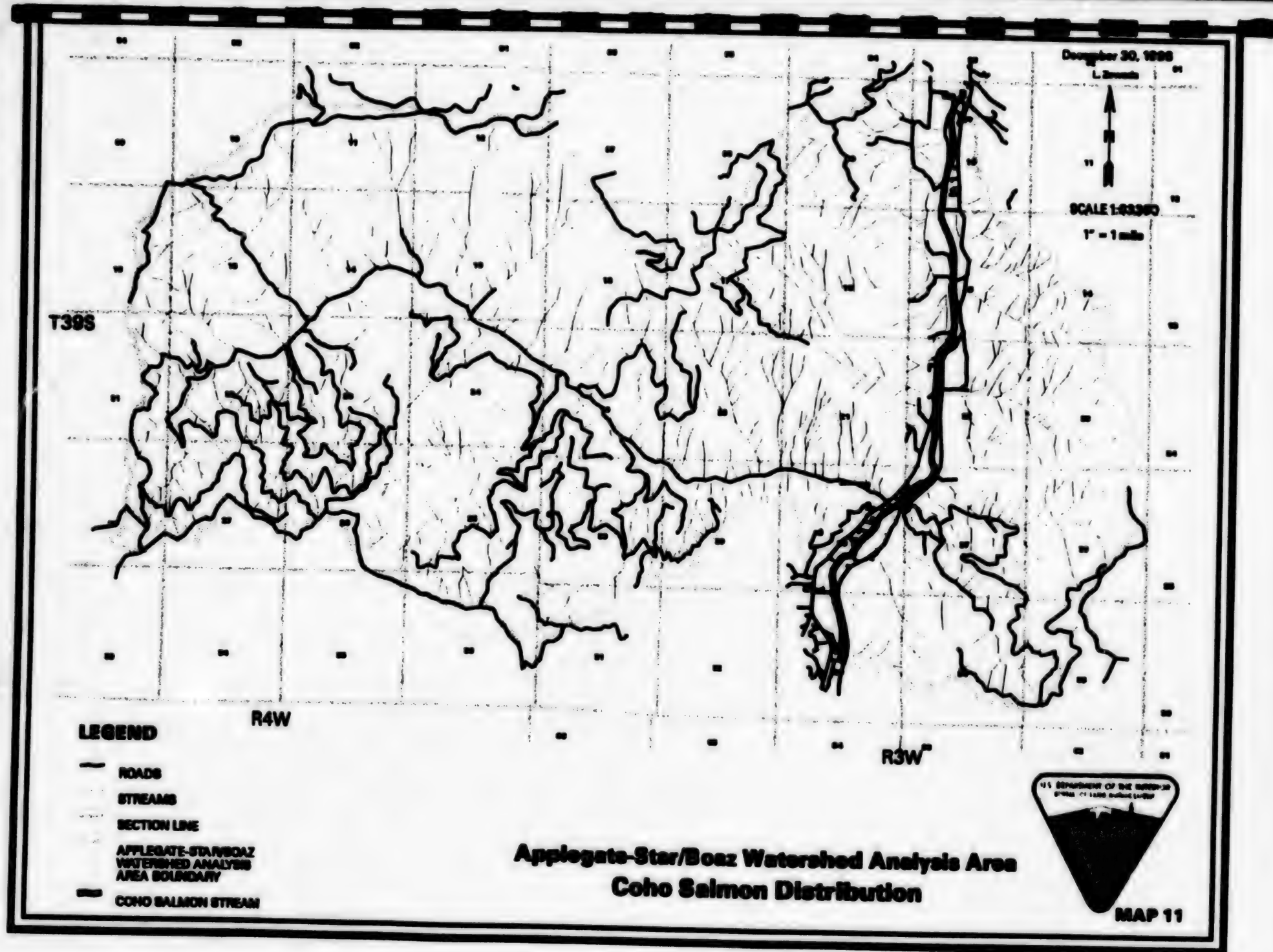
Applegate-Star/Boaz Watershed Analysis Area Intrinsic Soil Productivity

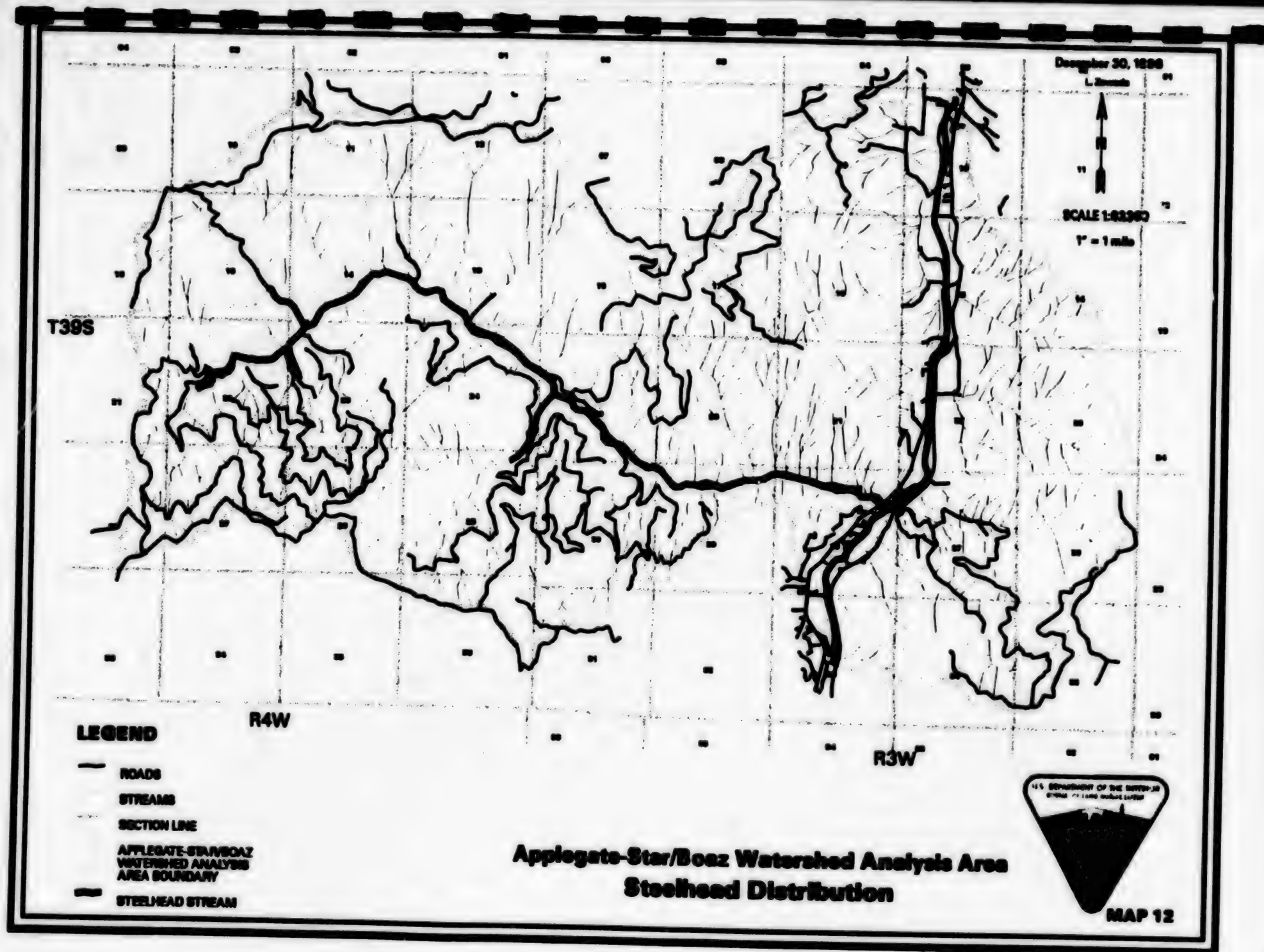


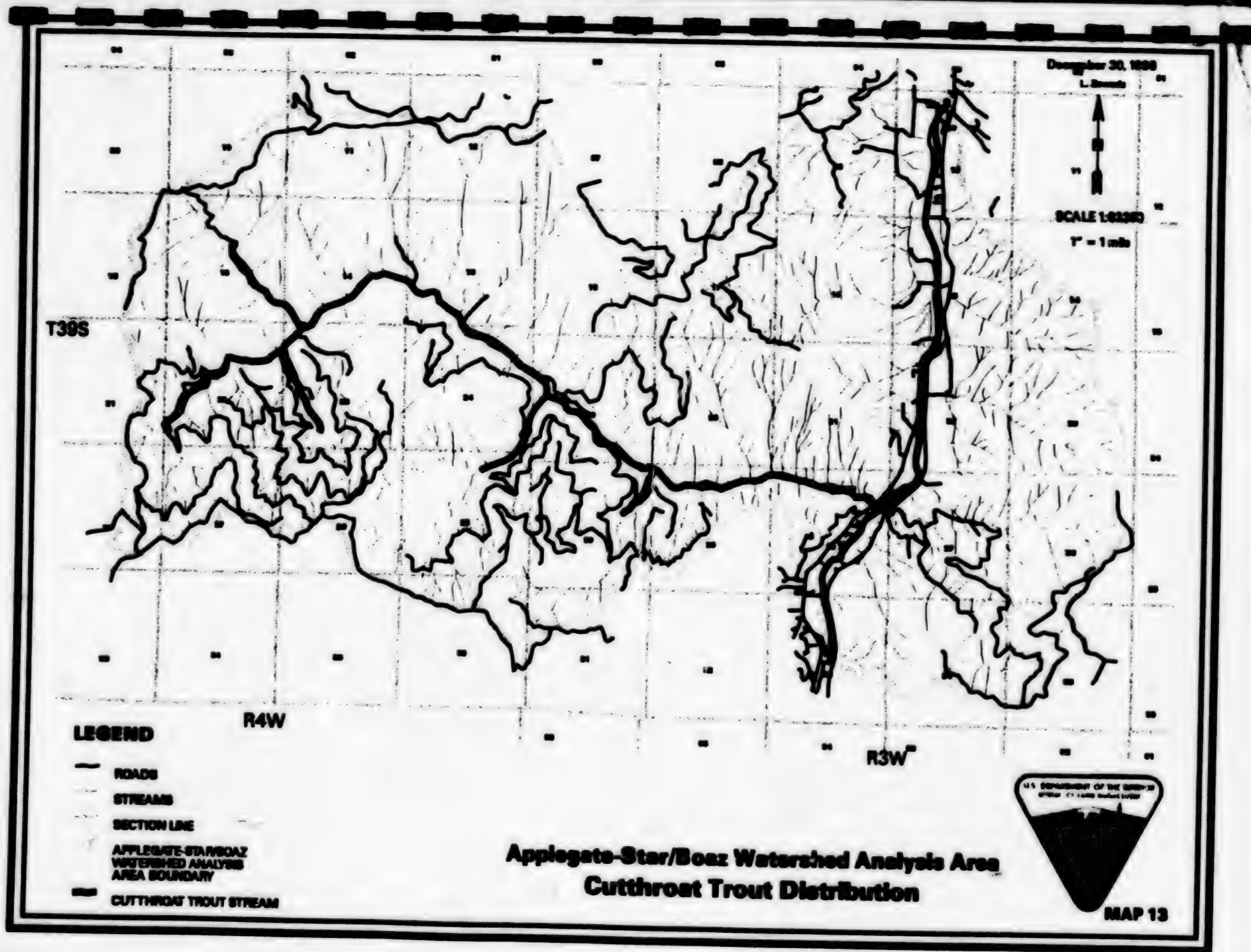
MAP 8

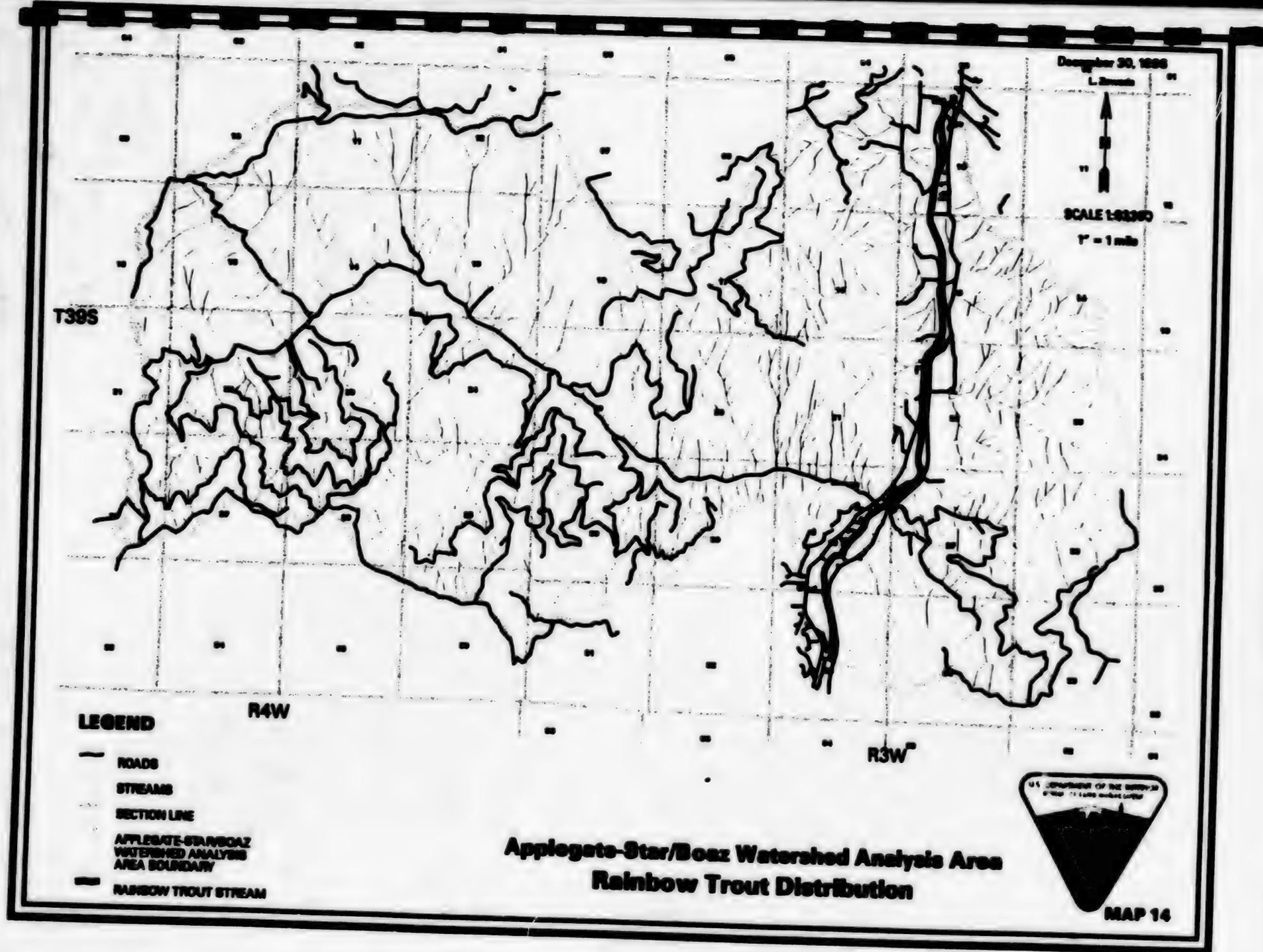


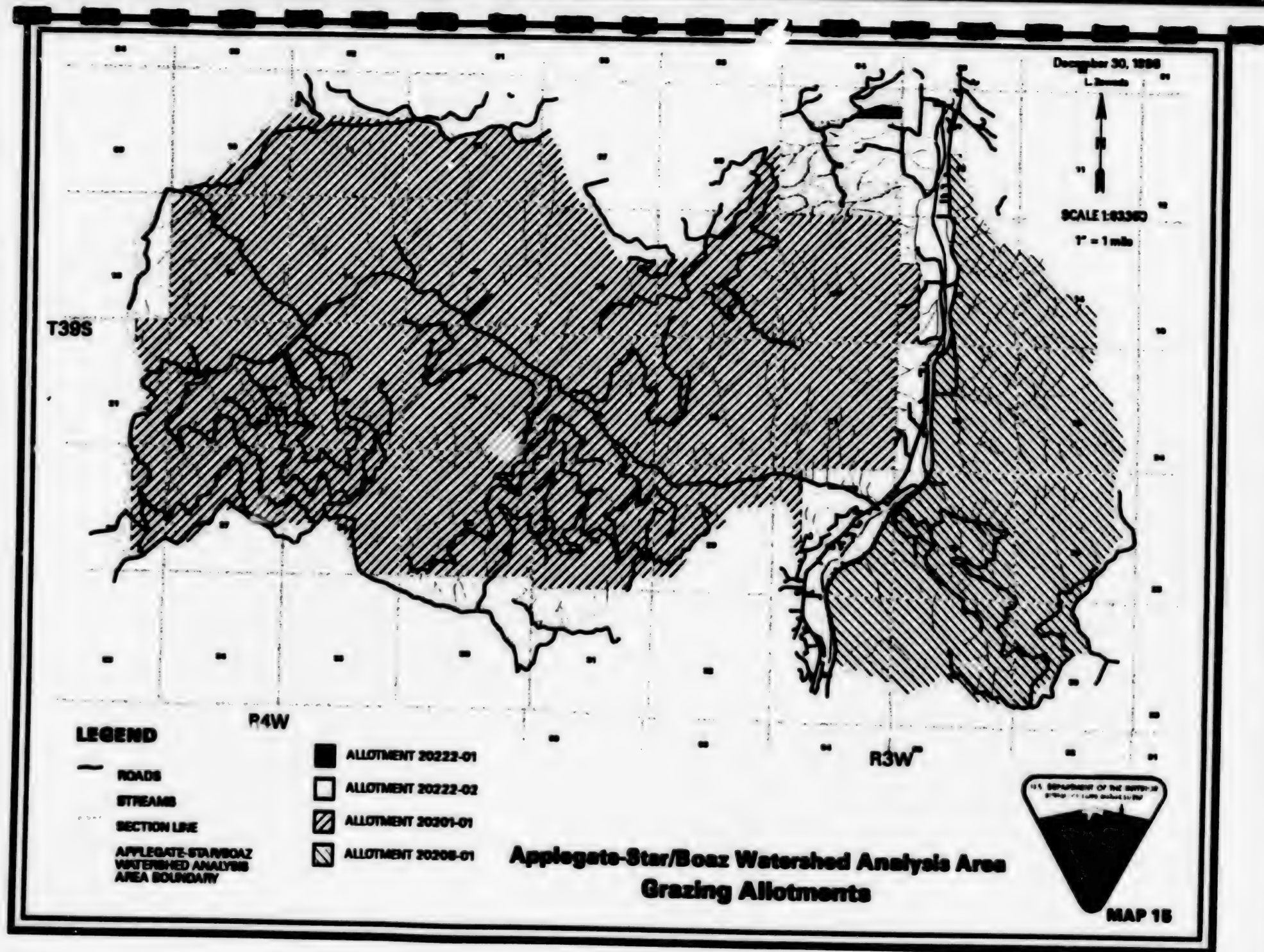


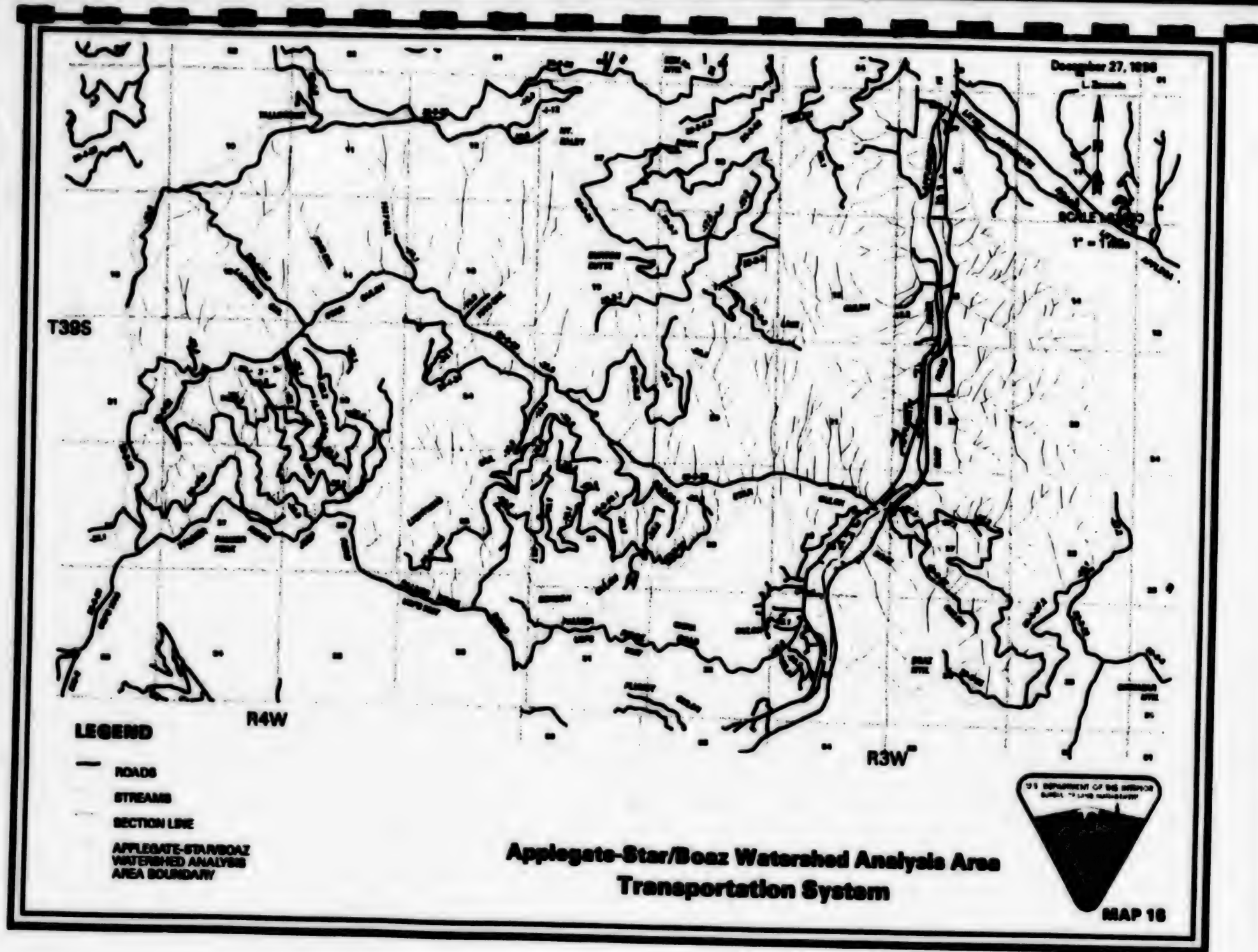












T39S

R4W

R3W

LEGEND

- ROADS
- STREAMS
- SECTION LINE
- APPLEGATE-STAR/BOAZ WATERSHED ANALYSIS AREA BOUNDARY
- LOW FUEL HAZARD
- MEDIUM FUEL HAZARD
- HIGH FUEL HAZARD

Applegate-Star/Boaz Watershed Analysis Area Fire Hazard

December 30, 1998

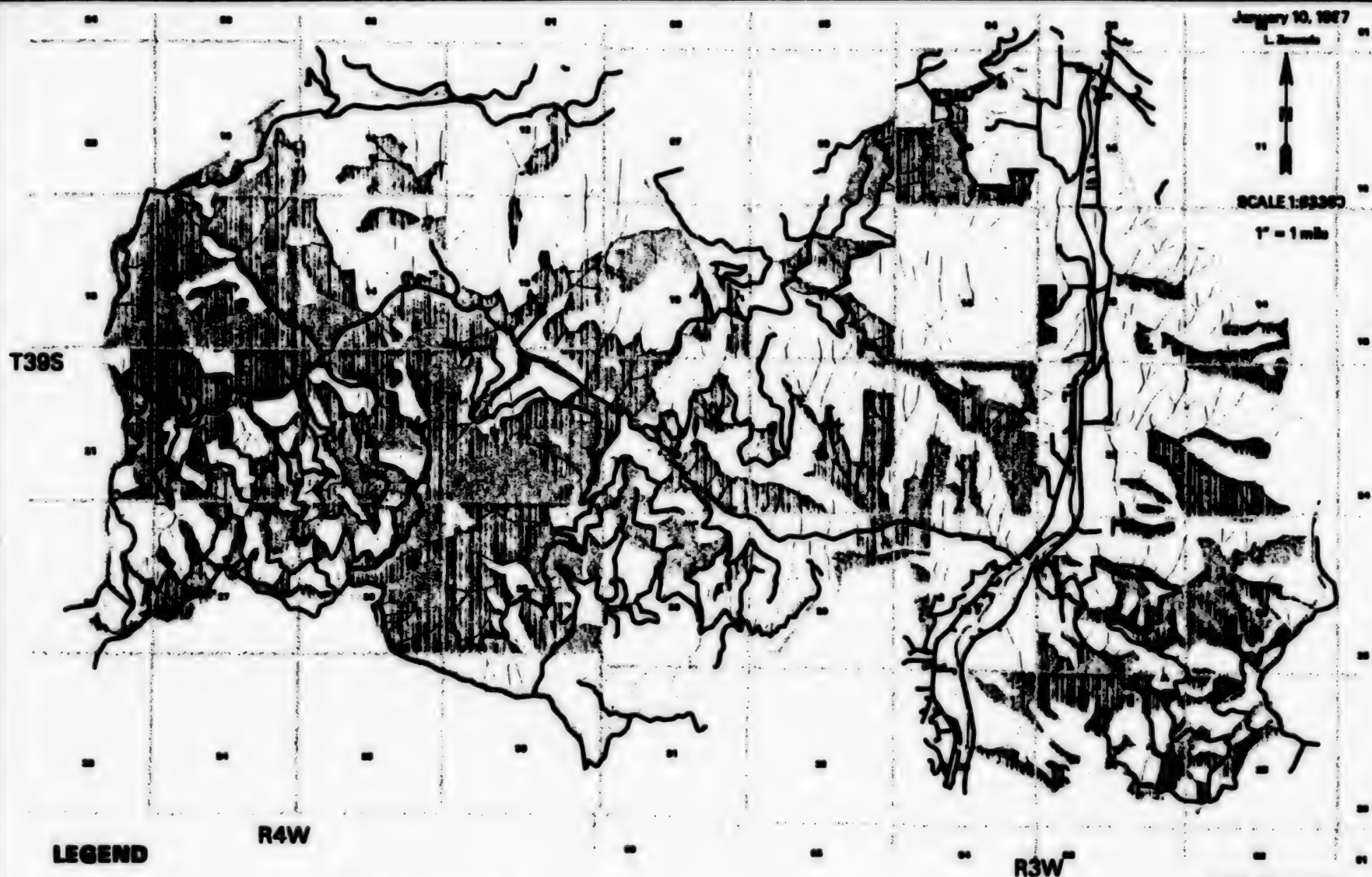
L. Swartz

SCALE 1:83360

1" = 1 mile



MAP 17



January 10, 1987
L. Swank
SCALE 1:83360
1" = 1 mile

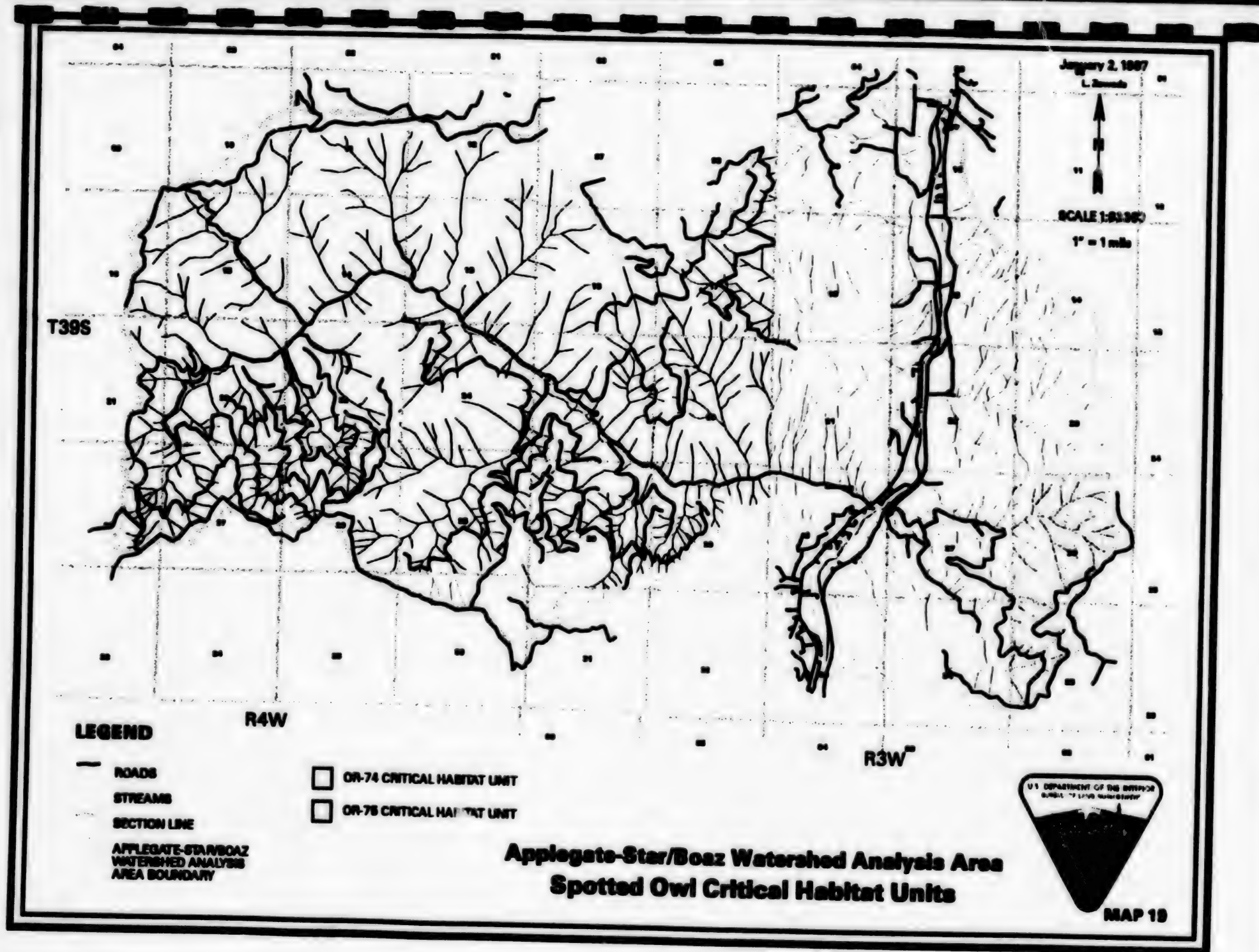
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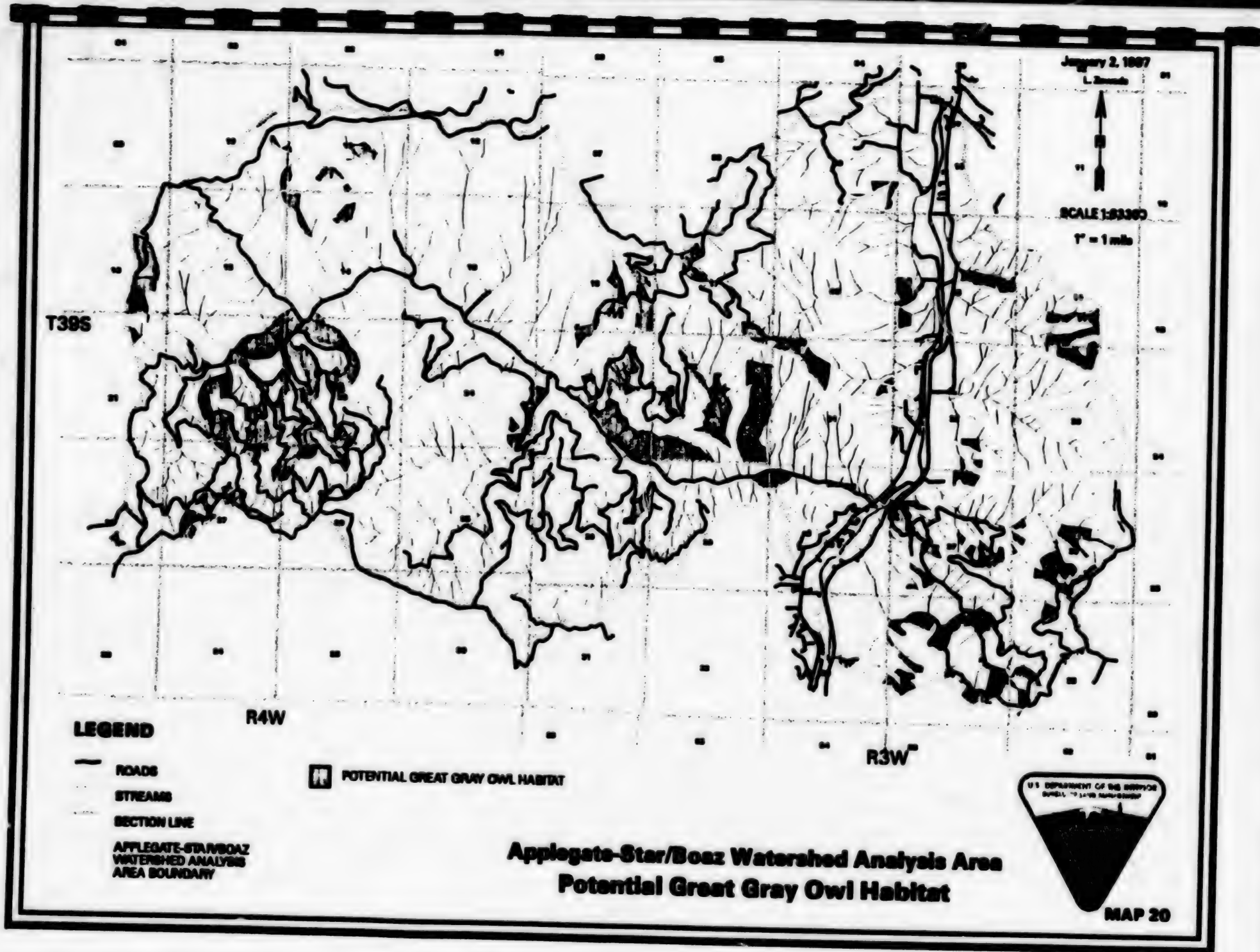
- ROADS
- STREAMS
- SECTION LINE
- APPLEGATE-STAR/BOAZ
WATERSHED ANALYSIS
AREA BOUNDARY
- SUITABLE HABITAT
- DISPERSAL HABITAT

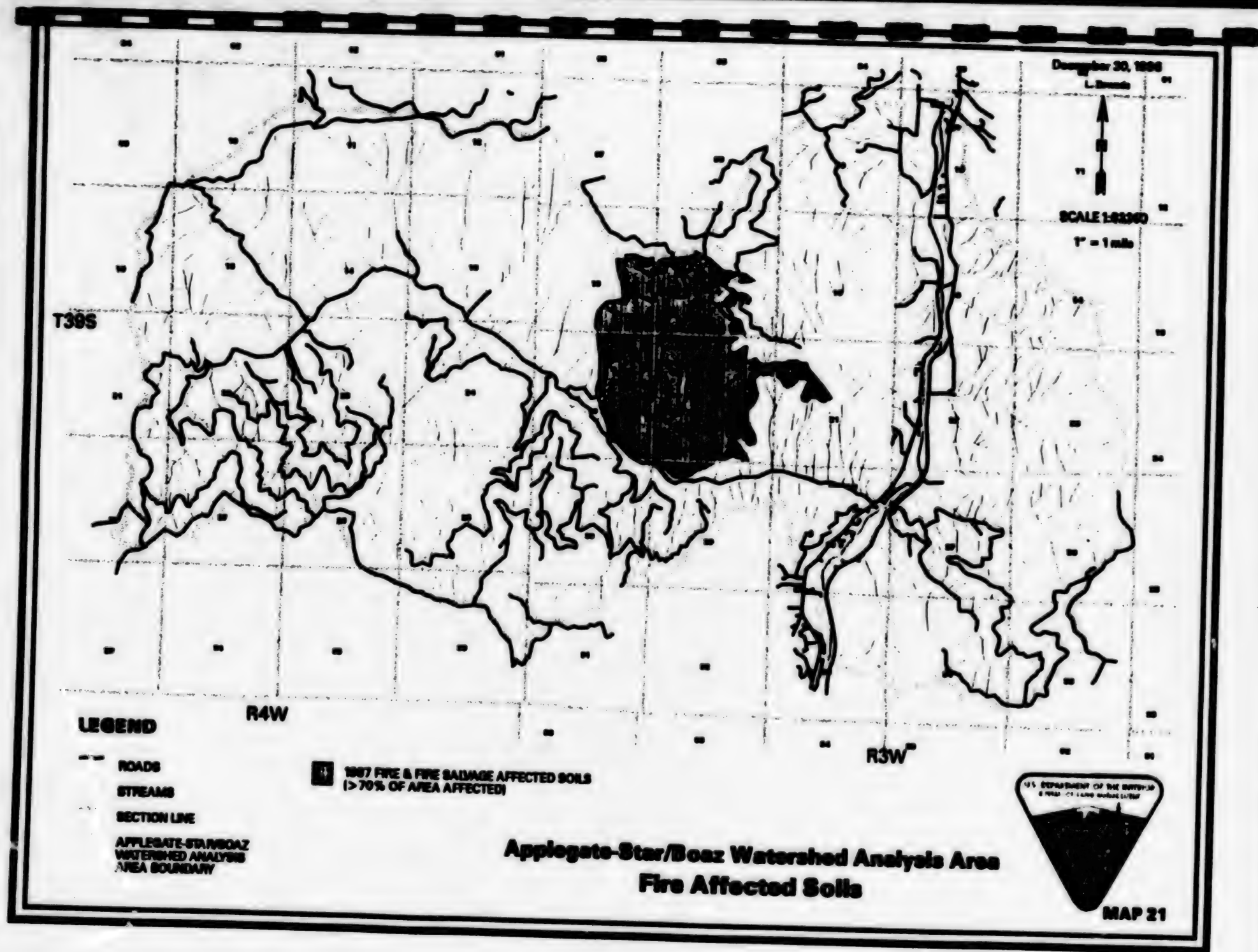
**Applegate-Star/Boaz Watershed Analysis Area
Spotted Owl Habitat Distribution**

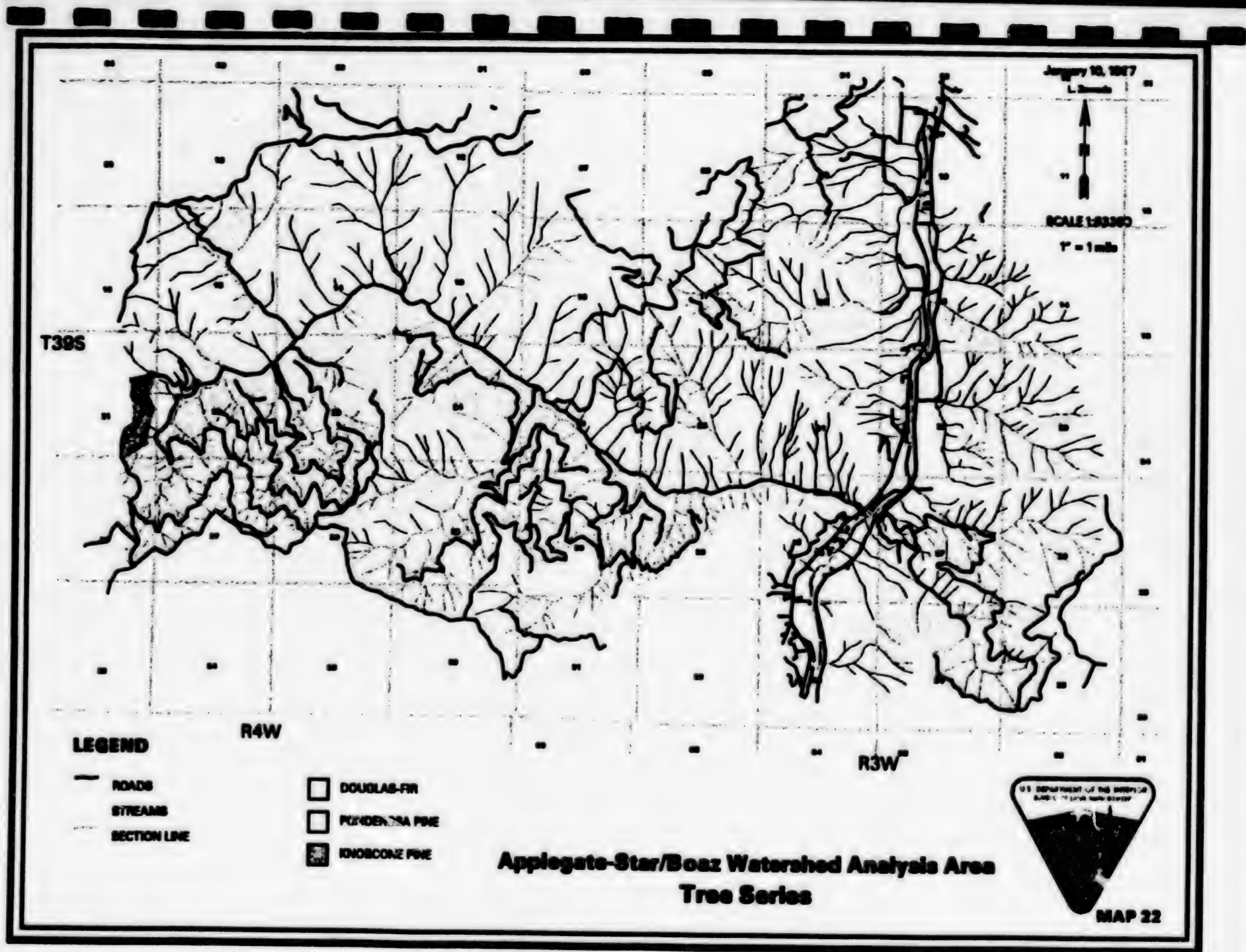


MAP 18









February 10, 1987

L. Brown

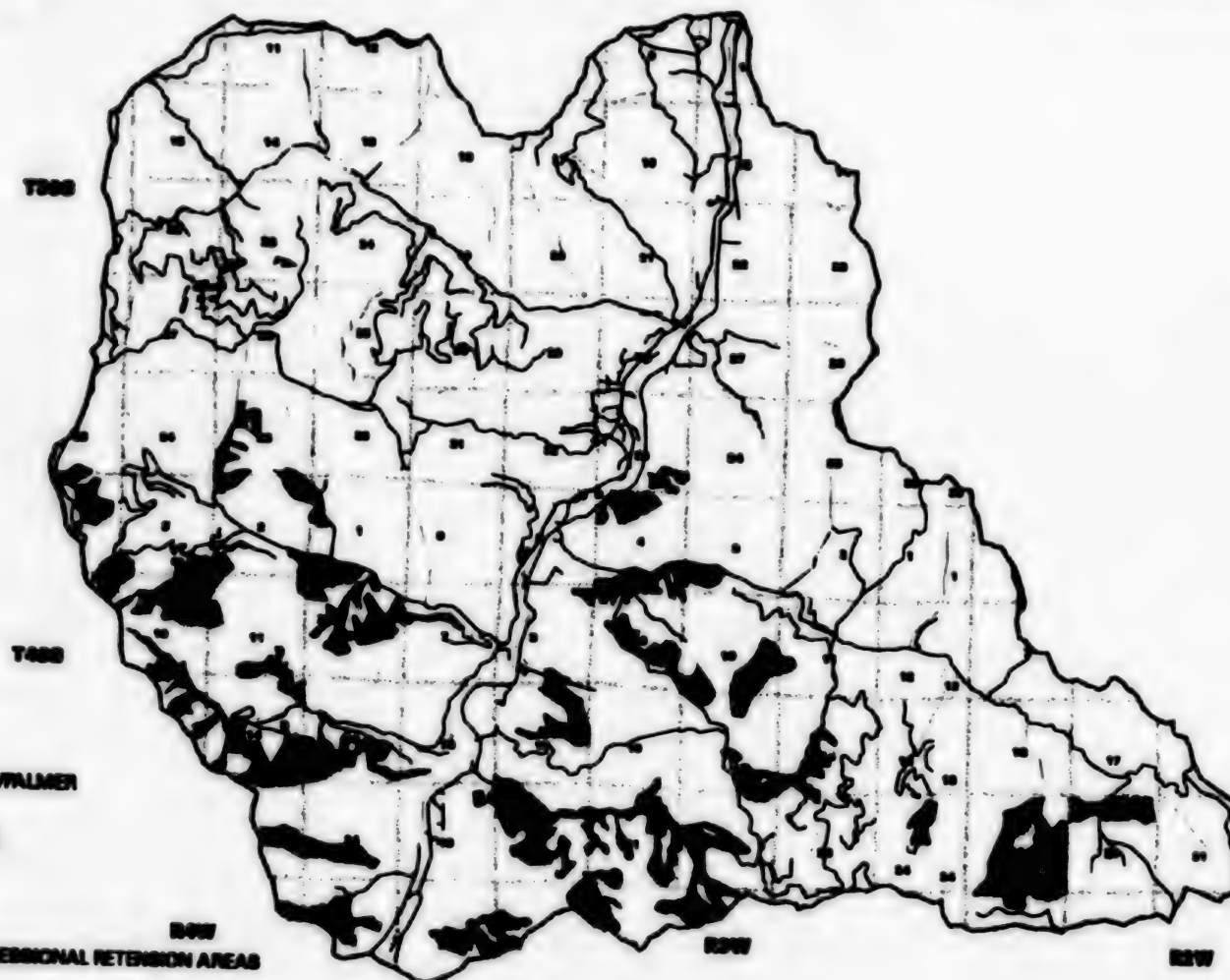


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1" = 2 miles

LEGEND

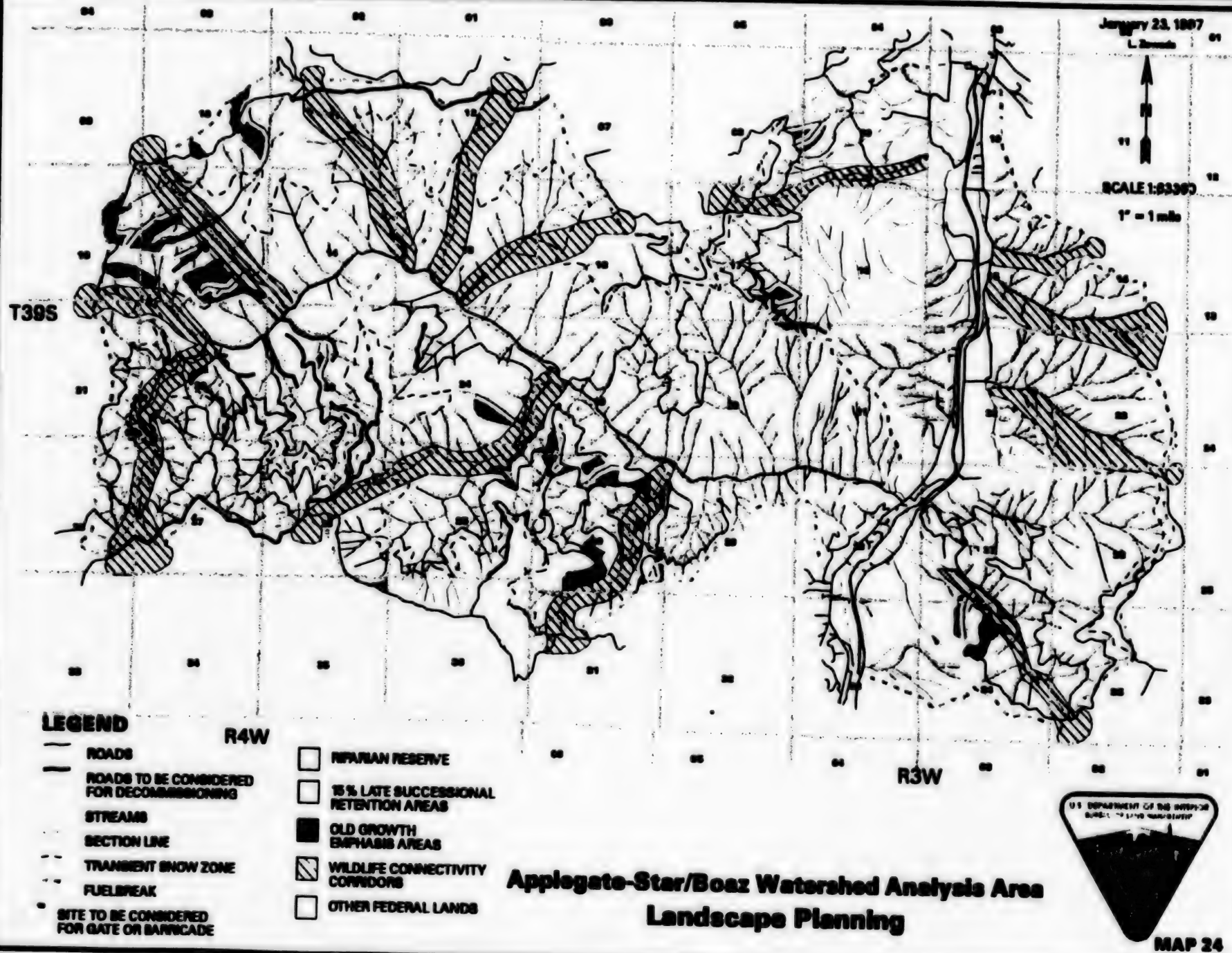
- STAR/BEAVER/PALMER WATERSHED
- SECTION LINE
- ROADS
- STREAMS
- BLM LATE-SUCCESSIONAL RETENTION AREAS
 - OLD GROWTH RIPARIAN RESERVE
 - OLD GROWTH DOUGLAS FIR RETENTION
 - OLD GROWTH PONDEROSA PINE RETENTION
 - OLD GROWTH CYPRIPIDIUM RETENTION
- USFS LATE-SUCCESSIONAL RETENTION AREAS
 - LATE-SUCCESSIONAL RETENTION



Star/Beaver/Palmer Fifth Field Watershed 15% Late-Successional Retention Areas



MAP 23



LIST OF PREPARERS

Team Member	Responsibility
Laurie Lindell	Team Leader, Editing, Climate, Hydrology, Stream Channel, and Water Quality
Jim McConnell	Facilitator
Cori Backen and Mark MacFarlane	Writer/Editor
Dave Maurer	Erosion Processes and Soil Productivity
Greg Chandler	Fire
Kate Winthrop	Human Uses and Public Involvement
Joe Hoppe	Lands and Mining
Joan Seavers	Plants
Jeanine Rossa	Riparian Areas and Aquatic Wildlife
John Samuelson	Roads
George Arnold	Terrestrial Wildlife
Scott Haupt and Kathleen Borovac	Vegetation
Support Team Members	
Brendan White, USFW	Fish and Wildlife
Larry Zowada and Jim Dow	Maps and GIS Information
Bill Moore and Billie Nicpon	Grazing
Dave Squires	Hydrologic Data
Bill Yocum	Logging Information
Steve Shade	Editing and Soils

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APPENDICES

APPENDIX A

HYDROLOGY

Table A1. Streamflow Information for Applegate River near Copper and Star Gulch Gaging Stations

Year	Applegate River near Copper ¹			Star Gulch ¹			
	Water Year ²			Water Year			Calendar Year
	Annual Mean Discharge (cfs)	Instantaneous Peak Flow (cfs)	Instantaneous Low Flow (cfs)	Annual Mean Discharge (cfs)	Instantan. Peak Flow (cfs)	Instantan. Low Flow (cfs)	Minimum Daily Mean Flow (cfs)
1961	412	7,000	25				
62	298	2,510	33				
63	574	12,500	44				
64	311	3,440	32				
65	669	29,000	30				
66	419	8,130	41				
67	498	9,480	39				
68	316	8,220	38				
69	462	3,240	35				
70	523	13,600	36				
71	692	10,500	38				
72	562	12,300	37				
73	222	1,940	28				
74	1,077	29,800	35				
75	471	6,790	35				
76	279	3,150	44				
77	79.8	857	19				
78	519	7,050	34				
79	250	3,450	12				
80	463	8,050	12				
81	178	2,130	1.5				
82	792	4,730	79				
83	829	4,640	191				1.60

Year	Applegate River near Copper ¹			Star Gulch ²			
	Water Year ³			Water Year			Calendar Year
	Annual Mean Discharge (cfs)	Instantaneous Peak Flow (cfs)	Instantaneous Low Flow (cfs)	Annual Mean Discharge (cfs)	Instantan. Peak Flow (cfs)	Instantan. Low Flow (cfs)	Minimum Daily Mean Flow (cfs)
84	595	4,470	112	9.81	153	0.83	0.92
85	355	2,980	81	5.31	153	0.24	0.30
86	397	4,510	27	3.11	110	0.01	0.03
87	260	1,680	85	2.05	91	0.00	0.00
88	226	1,380	87	1.33	37	0.00	0.00
89	355	4,640	101	3.09	50	0.06	0.09
90	203	1,070	112	1.44	45	0.00	0.00
91	182	407	78	1.63	34	0.00	0.00
92	157	441	94	0.60	6	0.00	0.00
93	449	4,250	109	4.66	144	0.00	0.06
94	163	546	109	1.07	40	0.00	0.00
95	593	4,720	107	7.93	226	0.00	0.33
96	5,870	3,820	142	9.45	111	0.25	0.34
97	732	18,800	127	15.10	1,050	0.27	NA

1/ USGS gaging station below Applegate Dam, drainage area = 225 mi.²

2/ USGS gaging station one mile above mouth of Star Gulch, drainage area = 16.0 mi.²

3/ Water year = October 1 - September 30 (e.g. water year 1997 = Oct. 1, 1996 - Sept. 30, 1997)

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Table A2. Ownership, Stream, and Road Information by Drainage Area

Drainage Area ¹	Area (acres)	Area (mi ²)	Ownership (percent)			% TSZ ²	Total Stream Miles	Drainage Density (mi/mi ²)	Total Road Miles ³	% BLM Roads ⁴	Road Density (mi/mi ²)	No. of Stream Crossings	Road Surface Type ⁵		
			BLM	USFS	Private								Natural	Rocked	Bitum.
AU1503	825	1.3	100	0	0	77	11.6	9.0	6.8	87	5.3	46	2.9	3.9	0.0
AU1506	155	0.2	100	0	0	51	2.4	10.0	1.3	100	5.4	7	1.1	0.2	0.0
AU1509	231	0.4	100	0	0	67	2.6	7.2	0.1	100	0.3	1	0.1	0.0	0.0
AU1512	134	0.2	100	0	0	0	0.9	4.3	0.8	75	3.8	2	0.4	0.4	0.0
AU1515	709	1.1	100	0	0	57	9.9	8.9	9.8	86	8.8	50	4.9	4.9	0.0
AU1518	263	0.4	100	0	0	29	2.6	6.3	1.6	69	3.9	6	1.4	0.2	0.0
AU1521	928	1.5	100	0	0	59	7.4	5.1	3.4	65	2.3	10	3.4	0.0	0.0
AU1524	93	0.2	100	0	0	0	0.8	5.3	0.5	100	3.3	3	0.0	0.0	0.5
AU1527	210	0.3	100	0	0	32	1.5	4.5	0.0	0	0.0	1	0.0	0.0	0.0
AU1530	191	0.3	100	0	0	2	1.9	6.3	0.6	100	2.0	4	0.0	0.0	0.6
AU1533	660	1.0	100	0	0	52	5.8	5.6	1.6	31	1.6	3	1.6	0.0	0.0
AU1536	577	0.9	100	0	0	32	4.0	4.4	1.7	82	1.9	8	1.1	0.0	0.6
AU1539	636	1.0	100	0	0	41	5.3	5.4	0.5	100	0.5	3	0.5	0.0	0.0
AU1542	736	1.2	100	0	0	13	6.5	5.7	2.9	100	2.5	15	1.8	0.2	0.9
AU1545	1,328	2.1	92	1	7	36	16.7	8.1	8.1	59	3.9	40	3.8	4.3	0.0
AU1548	865	1.4	100	0	0	12	9.5	7.0	6.6	98	4.9	33	1.7	3.9	1.0
AU1551	731	1.1	67	17	16	20	8.1	7.1	5.8	83	5.1	29	1.0	4.8	0.0
AU1554	1,179	1.8	100	0	0	4	16.6	9.0	5.0	100	2.7	30	1.6	2.3	1.1

Drainage Area ¹	Area (acres)	Area (mi ²)	Ownership (percent)			% TSZ ²	Total Stream Miles	Drainage Density (mi/mi ²)	Total Road Miles ³	% BLM Roads ⁴	Road Density (mi/mi ²)	No. of Stream Crossings	Road Surface Type ⁵		
			BLM	USFS	Private								Natural	Rocked	Bitum.
AU1557	396	0.6	73	15	12	0	6.1	9.8	1.2	75	1.9	12	0.3	0.0	0.9
Star Gulch Totals	10,847	17.0	96	2	2	33	120.2	7.1	58.3	82	3.4	303	27.6	25.1	5.6
AU1420	1,551	2.4	75	10	15	2	15.9	6.6	10.0	54	4.2	38	3.9	3.8	2.3
AU1560	2,926	4.6	75	5	20	2	36.9	8.1	9.8	32	2.1	34	3.1	2.9	3.8
AU1563	2,327	3.6	46	1	53	4	28.7	7.9	12.3	50	3.4	46	8.2	2.6	1.5
Applegate Frontals Totals	6,804	10.6	65	5	30	3	81.5	7.7	32.1	45	3.0	118	15.2	9.3	7.6
Analysis Area Totals	17,651	27.6	84	3	13	21	201.7	7.3	90.4	69	3.3	421	42.8	34.4	13.2

1/ Drainage Areas (Map 10):

AU1503 - Star Gulch headwaters down to BLM upper gage site
 AU1506 - Star Gulch below BLM upper gage site and above Deadman Gulch
 AU1509 - Deadman Gulch
 AU1512 - Star Gulch below Deadman Gulch and above Alexander Gulch
 AU1515 - Alexander Gulch
 AU1518 - Star Gulch below Alexander Gulch and above Ladybug Gulch
 AU1521 - Ladybug Gulch
 AU1524 - Star Gulch below Ladybug Gulch and above 1916 Gulch
 AU1527 - 1916 Gulch
 AU1530 - Star Gulch below 1916 Gulch and above 1917 Gulch
 AU1533 - 1917 Gulch

AU1536 - Star Gulch below 1917 Gulch and above 1918 Gulch
 AU1539 - 1918 Gulch
 AU1542 - Star Gulch below 1918 Gulch and above Lightning Gulch
 AU1545 - Lightning Gulch
 AU1548 - Star Gulch below Lightning Gulch and above Benson Gulch
 AU1551 - Benson Gulch
 AU1554 - Star Gulch below Benson Gulch and above USGS gaging station
 AU1557 - Star Gulch below USGS gaging station and above Applegate River
 AU1420 - Boaz Gulch area not included in USFS Beaver/Palmer WA
 AU1560 - Applegate River below Star Gulch and above Lime Gulch
 AU1563 - Applegate River from Lime Gulch to above Little Applegate

2/ Percent of the drainage area that is within the transient snow zone.

3/ Roads shown on GIS transportation theme.

4/ Roads with BLM control or on BLM land.

5/ Surface type for BLM roads from GIS; surface type for non-BLM roads estimated from aerial photos.

Table A3. Vegetation Condition Class by Drainage Area

Drainage Area ¹	Vegetation Condition Class ² (acres and percent)						
	1	2	3	4	5	6	7
AU1503	2 (<1%)	0	22 (3%)	76 (9%)	162 (19%)	443 (54%)	121 (15%)
AU1506	0	0	0	2 (1%)	47 (30%)	54 (35%)	52 (34%)
AU1509	0	0	76 (33%)	0	0	103 (45%)	51 (22%)
AU1512	0	0	2 (1%)	29 (21%)	1 (1%)	90 (67%)	13 (10%)
AU1515	1 (<1%)	0	1 (<1%)	225 (32%)	56 (8%)	347 (49%)	80 (11%)
AU1518	3 (1%)	3 (1%)	0	25 (10%)	90 (34%)	120 (46%)	22 (8%)
AU1521	23 (3%)	0	158 (17%)	0	57 (6%)	421 (45%)	269 (29%)
AU1524	0	0	0	0	0	75 (81%)	18 (19%)
AU1527	19 (9%)	0	80 (38%)	0	0	45 (22%)	66 (31%)
AU1530	0	0	28 (15%)	1 (<1%)	0	145 (76%)	17 (9%)
AU1533	50 (7%)	0	398 (60%)	25 (4%)	0	51 (8%)	136 (21%)
AU1536	17 (3%)	0	254 (44%)	16 (3%)	13 (2%)	156 (27%)	122 (21%)
AU1539	0	0	402 (63%)	23 (4%)	19 (3%)	163 (26%)	28 (4%)
AU1542	0	10 (1%)	163 (22%)	47 (7%)	171 (23%)	256 (35%)	90 (12%)
AU1545	0	0	6 (<1%)	33 (3%)	254 (19%)	526 (40%)	509 (38%)
AU1548	0	0	164 (19%)	219 (25%)	165 (19%)	276 (32%)	41 (5%)
AU1551	0	0	3 (<1%)	172 (24%)	220 (30%)	99 (14%)	237 (32%)
AU1554	0	25 (2%)	227 (19%)	347 (30%)	263 (22%)	293 (25%)	25 (2%)
AU1557	8 (2%)	0	178 (45%)	19 (5%)	132 (33%)	45 (11%)	14 (4%)

Drainage Area ¹	Vegetation Condition Class ² (acres and percent)						
	1	2	3	4	5	6	7
Star Gulch Totals	123 (1%)	38 (<1%)	2,162 (20%)	1,259 (12%)	1,650 (15%)	3,708 (34%)	1,911 (18%)
AU1420	222 (14%)	14 (1%)	576 (37%)	78 (5%)	64 (4%)	508 (33%)	88 (6%)
AU1560	427 (15%)	464 (16%)	812 (28%)	75 (2%)	175 (6%)	910 (31%)	63 (2%)
AU1563	400 (17%)	1 (<1%)	509 (22%)	100 (4%)	399 (17%)	782 (34%)	137 (6%)
Applegate Fork Totals	1,049 (16%)	479 (7%)	1,897 (28%)	253 (4%)	638 (9%)	2,200 (32%)	288 (4%)
Analysis Area Totals	1,172 (7%)	517 (3%)	4,059 (23%)	1,512 (9%)	2,288 (13%)	5,908 (33%)	2,199 (12%)

1/ Drainage Areas (Map 10):

- AU1503 - Star Gulch headwaters down to BLM upper gage site
- AU1506 - Star Gulch below BLM upper gage site and above Deadman Gulch
- AU1509 - Deadman Gulch
- AU1512 - Star Gulch below Deadman Gulch and above Alexander Gulch
- AU1515 - Alexander Gulch
- AU1518 - Star Gulch below Alexander Gulch and above Ladybug Gulch
- AU1521 - Ladybug Gulch
- AU1524 - Star Gulch below Ladybug Gulch and above 1916 Gulch
- AU1527 - 1916 Gulch
- AU1530 - Star Gulch below 1916 Gulch and above 1917 Gulch
- AU1533 - 1917 Gulch
- AU1536 - Star Gulch below 1917 Gulch and above 1918 Gulch
- AU1539 - 1918 Gulch
- AU1542 - Star Gulch below 1918 Gulch and above Lightning Gulch
- AU1545 - Lightning Gulch
- AU1548 - Star Gulch below Lightning Gulch and above Benson Gulch
- AU1551 - Benson Gulch
- AU1554 - Star Gulch below Benson Gulch and above USGS gaging station
- AU1557 - Star Gulch below USGS gaging station and above Applegate River
- AU1420 - Boaz Gulch area not included in USFS Beaver/Palmer WA
- AU1563 - Applegate River from (and including) Lime Gulch to above Little Applegate River

2/ Vegetation Condition Class Code:

- 1 = grass, forbs, herbaceous veg.
- 2 = shrubs, non-forest land
- 3 = hardwood/woodland
- 4 = early, 0-5 yrs. stand age (as of 10-1-92) and seedlings/saplings, 0-4.9" dbh
- 5 = poles, 5-11" dbh
- 6 = mid, 11-21" dbh
- 7 = mature/old-growth, 21" + dbh

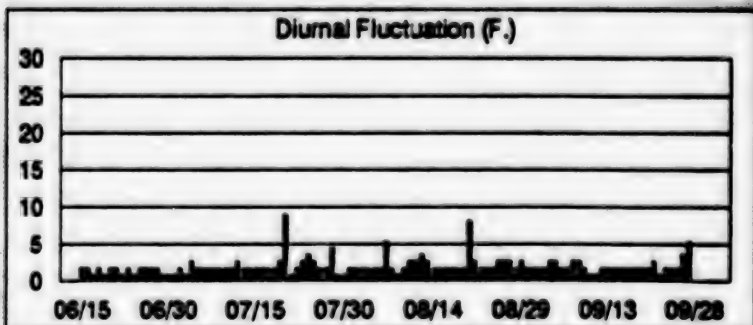
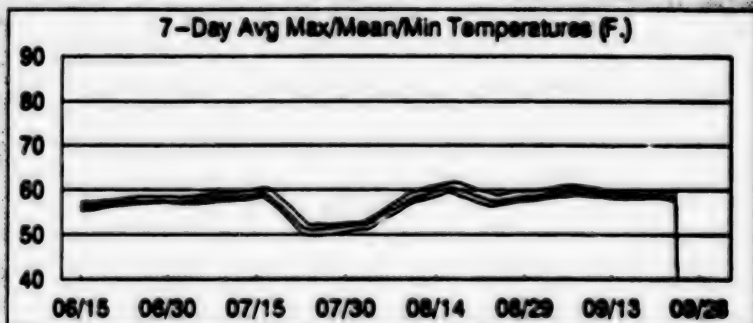
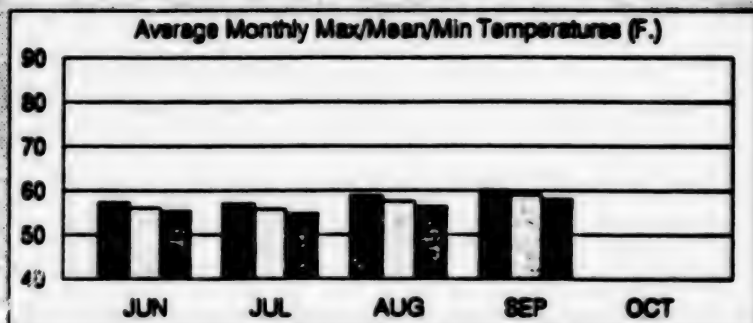
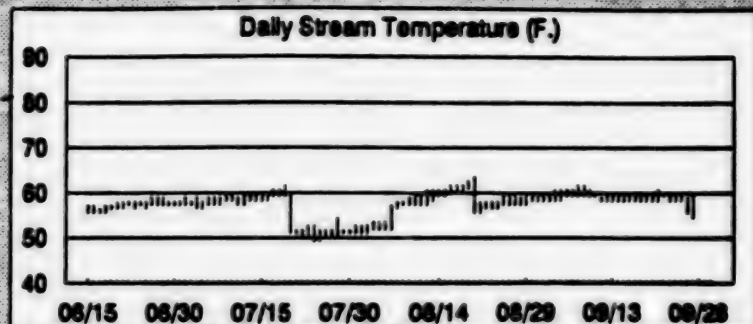
APPENDIX B
WATER QUALITY
Stream Temperature Data Summaries

Applegate River near Copper (Gaging Station below Applegate Dam) 1994

Stream Temperature Data

BLM Medford District Office, Site Code: APCP

Monthly Statistics	JUN	JUL	AUG	SEP	OCT
<i>Days of complete data:</i>	30	31	31	27	-
<i>Daily Maximums (F.)</i>					
highest maximum:	61.7	61.7	63.5	61.7	-
lowest maximum:	52.7	51.8	52.7	59.0	-
average maximum:	57.3	57.0	58.8	60.2	-
days with maximums <60:	29	28	22	19	-
days with maximums 60-65:	1	3	9	8	-
days with maximums 65-70:	-	-	-	-	-
days with maximums >70:	-	-	-	-	-
days exceeding 64.0: (CDEQ water quality standard)	-	-	-	-	-
<i>Daily minimums (F.)</i>					
highest minimum:	57.2	59.0	60.8	59.0	-
lowest minimum:	51.8	49.1	50.9	54.5	-
average minimum:	55.4	54.9	56.4	58.1	-
<i>Daily Means (F.)</i>					
highest mean:	58.1	59.9	61.7	59.9	-
lowest mean:	52.7	50.9	51.8	57.2	-
average mean:	56.2	55.9	57.5	59.0	-
<i>Daily diurnal fluctuation (F.)</i>					
highest diurnal fluctuation:	8.1	9.0	8.1	5.4	-
lowest diurnal fluctuation:	0.9	0.9	0.9	0.9	-
average diurnal fluctuation:	1.9	2.2	2.4	2.1	-
<i>7-day avg. maximums (F.)</i>					
highest 7-day avg. maximum:	58.6	60.4	61.8	61.1	-
lowest 7-day avg. maximum:	56.4	52.1	52.7	59.8	-
mean 7-day avg. maximum:	57.8	57.0	58.8	60.2	-
<i>7-day avg. minimums (F.)</i>					
highest 7-day avg. minimum:	57.2	58.5	59.5	58.9	-
lowest 7-day avg. minimum:	53.3	49.7	51.2	57.3	-
mean 7-day avg. minimum:	55.6	54.6	56.4	58.3	-
<i>7-day average means (F.)</i>					
highest 7-day avg. mean:	57.7	59.4	60.4	59.6	-
lowest 7-day avg. mean:	54.6	51.0	52.2	58.5	-
mean 7-day avg. mean:	56.4	55.8	57.5	59.2	-
<i>7-day average diurnal fluctuation (F.)</i>					
highest 7-day avg. mean:	3.1	3.3	3.1	2.8	-
lowest 7-day avg. mean:	1.3	1.4	1.5	1.5	-
mean 7-day avg. mean:	1.9	2.2	2.4	1.9	-



Statistics for the period of the 7-day Maximum

The warmest 7-day period of stream temperature daily maximums centered on: 08/17

7-day average maximum temperature (F.): 61.8

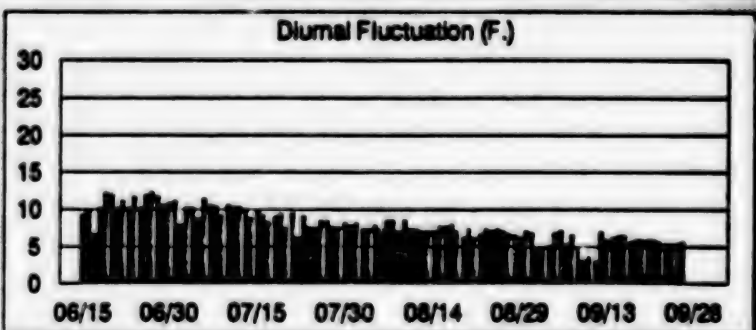
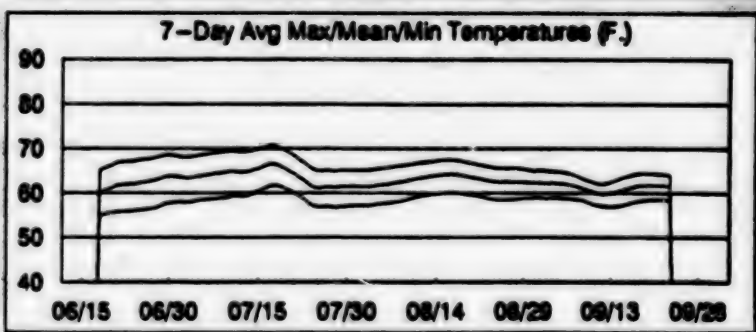
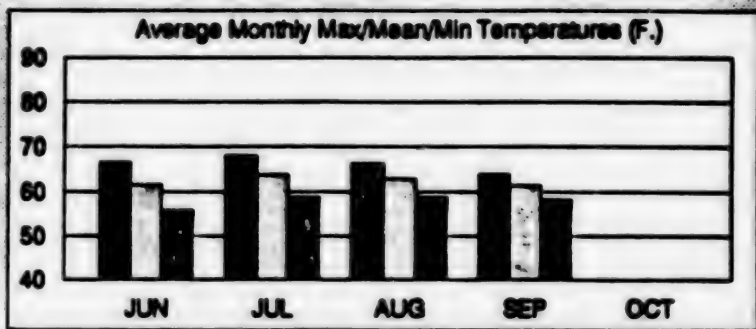
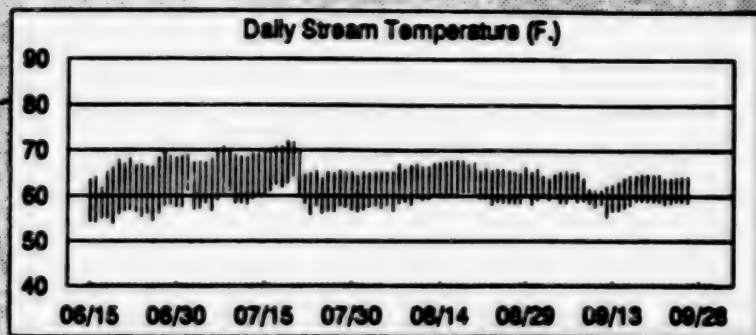
Daily Statistics for this period:

	08/14	08/15	08/16	08/17	08/18	08/19	08/20
maximum (F.):	60.8	60.8	61.7	61.7	61.7	62.8	63.5
minimum (F.):	59.0	59.0	59.9	59.9	59.9	60.8	61.4
mean (F.):	59.9	59.9	60.8	60.8	60.8	61.7	62.4
diurnal fluctuation (F.):	1.8	1.8	1.8	1.8	1.8	1.8	2.1

Applegate River above Little Applegate River 1994

Stream Temperature Data
BLM Medford District Office, Site Code: UPAP

Monthly Statistics	JUN	JUL	AUG	SEP	OCT
Days of complete data:	18	31	31	28	-
Daily Maximums (F.)					
highest maximum:	69.8	72.0	67.8	66.5	-
lowest maximum:	61.8	61.1	65.0	61.2	-
average maximum:	66.8	68.0	68.2	63.8	-
days with maximums <60:	-	-	-	-	-
days with maximums 60-65:	3	5	2	23	-
days with maximums 65-70:	13	19	29	3	-
days with maximums >70:	-	7	-	-	-
days exceeding 64.0: (COEQ water quality standard)	14	30	31	15	-
Daily minimums (F.)					
highest minimum:	58.1	64.1	60.8	59.5	-
lowest minimum:	53.9	55.9	58.7	55.0	-
average minimum:	55.8	59.8	58.8	58.2	-
Daily Means (F.)					
highest mean:	64.3	66.3	64.8	62.9	-
lowest mean:	57.8	60.5	61.4	58.8	-
average mean:	61.6	63.8	62.9	61.4	-
Daily diurnal fluctuation (F.)					
highest diurnal fluctuation:	12.3	11.5	8.8	7.2	-
lowest diurnal fluctuation:	6.8	6.3	6.3	3.1	-
average diurnal fluctuation:	10.7	9.2	7.4	5.8	-
7-day avg. maximums (F.)					
highest 7-day avg. maximum:	68.8	70.8	67.5	65.1	-
lowest 7-day avg. maximum:	65.1	64.9	65.0	62.1	-
mean 7-day avg. maximum:	67.2	68.0	66.2	63.8	-
7-day avg. minimums (F.)					
highest 7-day avg. minimum:	57.8	61.7	60.1	59.0	-
lowest 7-day avg. minimum:	55.0	56.8	57.2	57.0	-
mean 7-day avg. minimum:	56.2	58.8	58.8	58.2	-
7-day average means (F.)					
highest 7-day avg. mean:	63.8	66.5	64.3	62.3	-
lowest 7-day avg. mean:	60.2	61.2	61.5	58.8	-
mean 7-day avg. mean:	62.1	63.8	62.9	61.3	-
7-day average diurnal fluctuation (F.)					
highest 7-day avg. mean:	11.4	10.5	8.0	6.3	-
lowest 7-day avg. mean:	10.1	7.8	6.0	4.8	-
mean 7-day avg. mean:	11.0	9.2	7.3	5.7	-



Statistics for the period of the 7-day Maximum

The warmest 7-day period of stream temperature daily maximums centered on: 07/18

7-day average maximum temperature (F.): 70.8

Daily Statistics for the period:

	07/15	07/16	07/17	07/18	07/19	07/20	07/21
maximum (F.):	69.8	70.2	70.8	70.8	72.0	71.7	69.9
minimum (F.):	60.1	60.9	62.3	61.8	62.8	64.1	60.4
mean (F.):	65.3	66.0	66.8	66.7	67.5	68.3	65.0
diurnal fluctuation (F.):	9.8	9.3	8.5	9.0	9.4	7.6	9.6

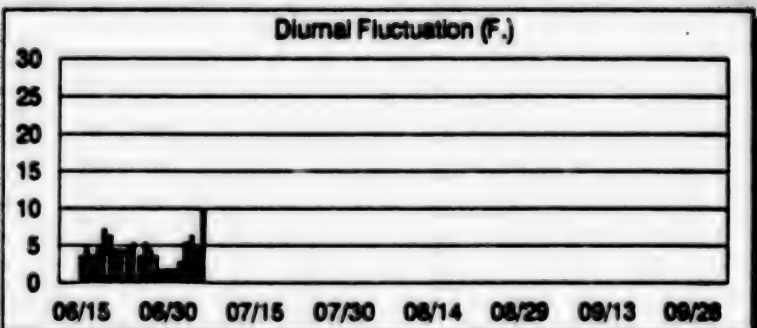
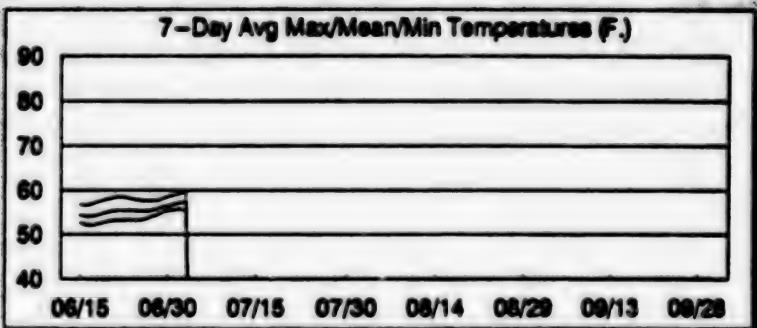
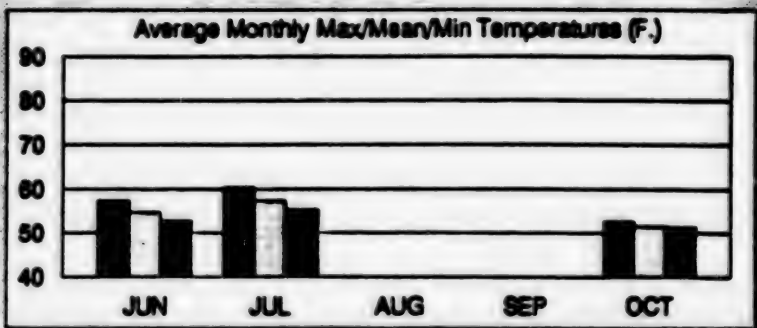
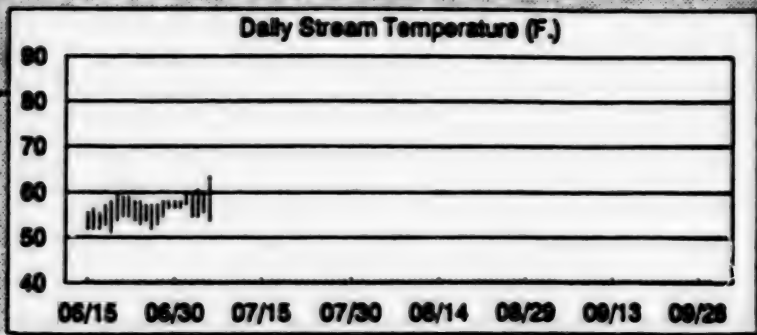
DAVID - BLM MEDFORD 05/01/95

Star Gulch @ USGS Gaging Station, above Applegate River confluence 1994

Stream Temperature Data

BLM Medford District Office, Site Code: STPL

Monthly Statistics	JUN	JUL	AUG	SEP	OCT
Days of complete data:	30	6	-	-	7
Daily & minimums (F.)					
highest maximum:	66.9	63.5	-	-	63.6
lowest maximum:	63.6	58.1	-	-	61.9
average maximum:	57.4	60.4	-	-	62.6
days with maximums <60:	30	4	-	-	7
days with maximums 60-65:	-	2	-	-	-
days with maximums 65-70:	-	-	-	-	-
days with maximums >70:	-	-	-	-	-
days exceeding 64.0: (DOEC water quality standard)	-	-	-	-	-
Daily minimums (F.)					
highest minimum:	56.3	57.2	-	-	61.8
lowest minimum:	48.2	53.6	-	-	60.9
average minimum:	52.6	55.3	-	-	61.4
Daily Means (F.)					
highest mean:	57.2	58.1	-	-	61.8
lowest mean:	50.9	57.2	-	-	60.9
average mean:	54.7	57.4	-	-	61.5
Daily diurnal fluctuation (F.)					
highest diurnal fluctuation:	7.2	9.9	-	-	2.7
lowest diurnal fluctuation:	1.8	1.8	-	-	0.9
average diurnal fluctuation:	4.6	5.1	-	-	1.2
7-day avg. maximums (F.)					
highest 7-day avg. maximum:	58.5	60.0	-	-	62.6
lowest 7-day avg. maximum:	55.7	59.0	-	-	62.6
mean 7-day avg. maximum:	57.3	60.4	-	-	62.6
7-day avg. minimums (F.)					
highest 7-day avg. minimum:	55.4	55.8	-	-	61.4
lowest 7-day avg. minimum:	51.2	55.4	-	-	61.4
mean 7-day avg. minimum:	52.8	56.6	-	-	61.4
7-day average means (F.)					
highest 7-day avg. mean:	58.8	57.3	-	-	61.5
lowest 7-day avg. mean:	53.1	56.9	-	-	61.5
mean 7-day avg. mean:	54.7	57.2	-	-	61.5
7-day average diurnal fluctuation (F.)					
highest 7-day avg. mean:	5.5	4.8	-	-	1.2
lowest 7-day avg. mean:	3.1	3.3	-	-	1.2
mean 7-day avg. mean:	4.5	3.8	-	-	1.2



Statistics for the period of the 7-day Maximum

The warmest 7-day period of stream temperature daily maximums centered on: 07/03

7-day average maximum temperature (F.): 60.0

Daily Statistics for this period:

	06/30	07/01	07/02	07/03	07/04	07/05	07/06
maximum (F.):	58.1	58.1	59.9	59.9	60.8	59.9	63.5
minimum (F.):	56.3	56.3	57.2	54.5	54.5	55.4	53.6
mean (F.):	57.2	57.2	58.1	57.2	57.2	57.2	57.2
diurnal fluctuation (F.):	1.8	1.8	2.7	5.4	6.3	4.5	9.9

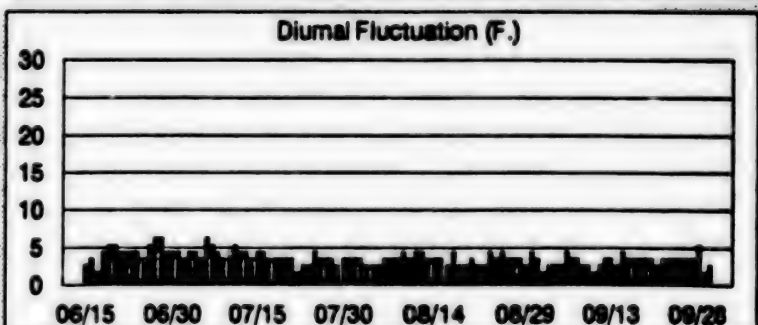
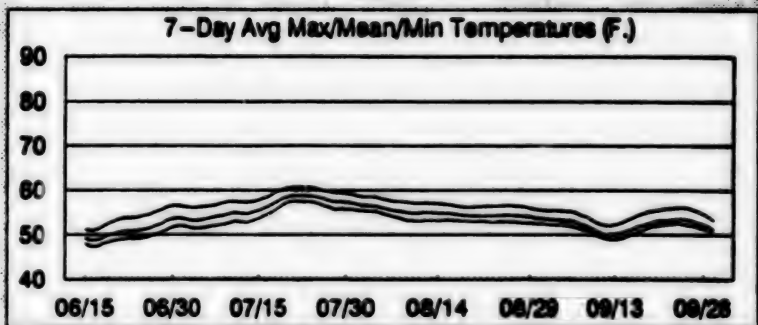
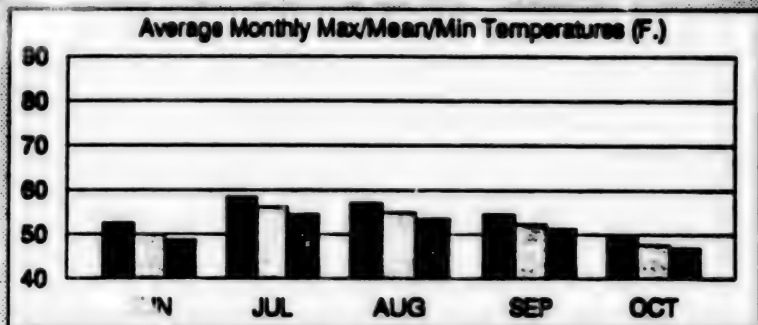
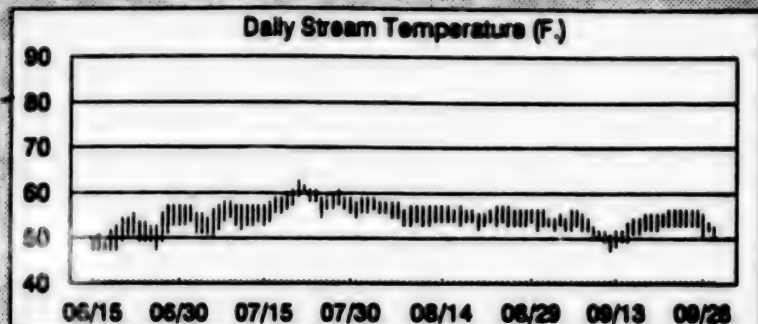
Star Gulch above Deadman Gulch

1994

Stream Temperature Data

BLM Medford District Office, Site Code: STRU

Monthly Statistics	JUN	JUL	AUG	SEP	OCT
Days of complete data:	30	31	31	30	14
Daily Maximums (F.)					
highest maximum:	57.2	62.6	69.0	66.3	62.7
lowest maximum:	49.2	54.5	55.4	50.9	47.3
average maximum:	52.6	58.4	57.1	54.5	49.4
days with maximums <50:	30	25	31	30	14
days with maximums 50-55:	-	9	-	-	-
days with maximums 55-70:	-	-	-	-	-
days with maximums >70:	-	-	-	-	-
days exceeding 64.0: (CDEQ water quality standard)	-	-	-	-	-
Daily minimums (F.)					
highest minimum:	52.7	59.9	56.3	52.7	50.9
lowest minimum:	45.5	50.0	51.8	47.3	44.6
average minimum:	48.7	54.5	53.5	51.3	47.0
Daily Means (F.)					
highest mean:	54.5	59.9	57.2	54.5	50.9
lowest mean:	46.4	51.8	53.6	49.1	45.5
average mean:	50.1	56.1	55.0	52.3	47.7
Daily diurnal fluctuation (F.)					
highest diurnal fluctuation:	6.3	6.3	4.5	5.4	3.6
lowest diurnal fluctuation:	1.8	1.8	2.7	1.8	0.9
average diurnal fluctuation:	3.9	3.9	3.5	3.3	2.4
7-day avg. maximums (F.)					
highest 7-day avg. maximum:	56.7	60.8	58.7	56.2	51.9
lowest 7-day avg. maximum:	50.0	56.2	55.7	52.1	49.1
mean 7-day avg. maximum:	52.5	58.4	57.0	54.5	49.7
7-day avg. minimums (F.)					
highest 7-day avg. minimum:	51.8	57.7	55.5	52.7	49.1
lowest 7-day avg. minimum:	47.2	51.5	52.6	49.0	46.3
mean 7-day avg. minimum:	48.7	54.5	53.5	51.2	47.2
7-day average means (F.)					
highest 7-day avg. mean:	53.7	58.9	56.9	53.6	50.0
lowest 7-day avg. mean:	48.1	53.3	53.7	50.0	47.2
mean 7-day avg. mean:	50.0	56.1	54.9	52.3	47.9
7-day average diurnal fluctuation (F.)					
highest 7-day avg. mean:	5.0	4.9	4.0	3.9	2.8
lowest 7-day avg. mean:	2.3	3.1	3.1	2.8	2.2
mean 7-day avg. mean:	3.9	4.0	3.5	3.3	2.5



Statistics for the period of the 7-day Maximum

The warmest 7-day period of stream temperature daily maximums centered on: 07/21

7-day average maximum temperature (F.): 60.8

Daily Statistics for this period:

	07/18	07/19	07/20	07/21	07/22	07/23	07/24
maximum (F.):	56.0	59.9	60.8	62.6	61.7	60.8	60.8
minimum (F.):	55.4	56.3	57.2	56.0	56.9	55.1	55.1
mean (F.):	57.2	58.1	59.0	59.9	59.9	58.0	58.0
diurnal fluctuation (F.):	3.6	3.6	3.6	3.6	1.8	2.7	2.7

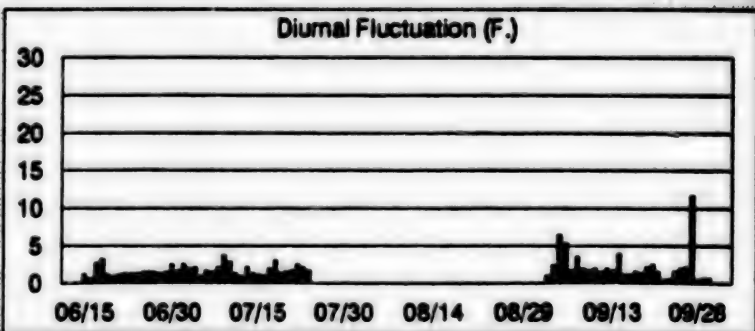
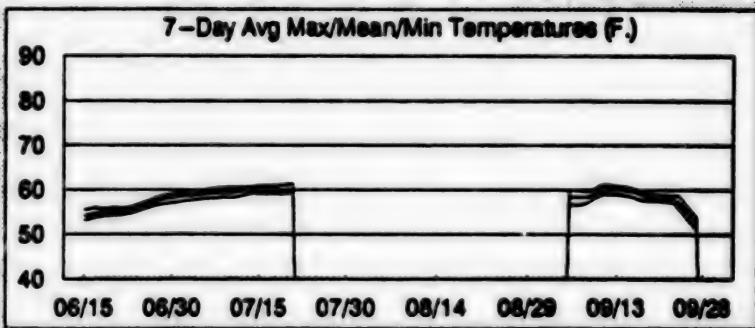
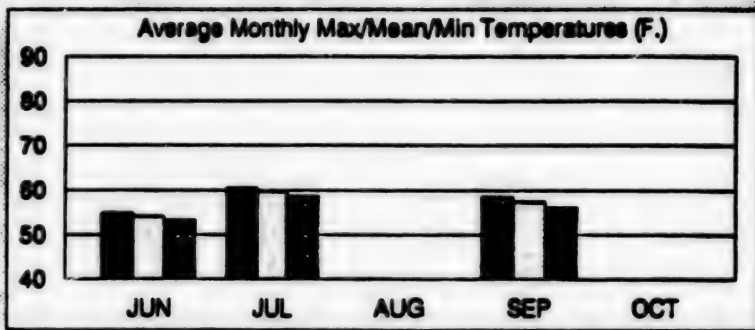
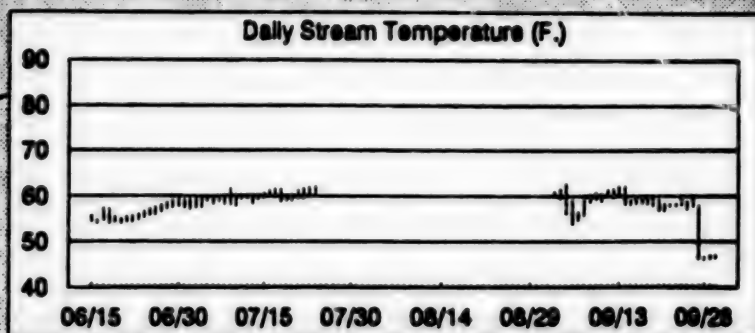
REPORTED BY: J. L. HARRIS DATE: 08/01/94

Applegate River near Copper (@ Gaging Station below Applegate Dam) 1995

Stream Temperature Data

BLM Medford District Office, Site Code: APOC

Monthly Statistics	JUN	JUL	AUG	SEP	OCT
<i>Days of complete data:</i>	30	24	-	29	-
<i>Daily Maximums (F.)</i>					
highest maximum:	60.1	62.1	-	62.6	-
lowest maximum:	51.8	59.2	-	49.6	-
average maximum:	56.0	60.6	-	58.5	-
days with maximums <60:	29	6	-	19	-
days with maximums 60-65:	1	18	-	10	-
days with maximums 65-70:	-	-	-	-	-
days with maximums >70:	-	-	-	-	-
days exceeding 64.0: (COEO water quality standard)	-	-	-	-	-
<i>Daily minimums (F.)</i>					
highest minimum:	57.6	60.3	-	60.3	-
lowest minimum:	50.5	56.6	-	48.0	-
average minimum:	53.3	58.6	-	56.2	-
<i>Daily Means (F.)</i>					
highest mean:	58.6	61.0	-	61.3	-
lowest mean:	51.3	56.5	-	48.4	-
average mean:	54.2	59.6	-	57.4	-
<i>Daily diurnal fluctuation (F.)</i>					
highest diurnal fluctuation:	5.0	3.8	-	11.7	-
lowest diurnal fluctuation:	0.7	1.1	-	0.5	-
average diurnal fluctuation:	1.7	1.9	-	2.4	-
<i>7-day avg. maximums (F.)</i>					
highest 7-day avg. maximum:	58.1	61.3	-	61.3	-
lowest 7-day avg. maximum:	52.2	59.3	-	53.6	-
mean 7-day avg. maximum:	55.3	60.4	-	59.3	-
<i>7-day avg. minimums (F.)</i>					
highest 7-day avg. minimum:	57.1	59.2	-	59.1	-
lowest 7-day avg. minimum:	50.9	57.3	-	51.0	-
mean 7-day avg. minimum:	53.6	58.5	-	57.1	-
<i>7-day average means (F.)</i>					
highest 7-day avg. mean:	58.3	60.1	-	60.4	-
lowest 7-day avg. mean:	51.6	56.5	-	52.2	-
mean 7-day avg. mean:	54.5	59.5	-	58.3	-
<i>7-day average diurnal fluctuation (F.)</i>					
highest 7-day avg. mean:	2.2	2.2	-	3.3	-
lowest 7-day avg. mean:	1.3	1.5	-	1.5	-
mean 7-day avg. mean:	1.7	1.9	-	2.2	-



Statistics for the period of the 7-day Maximum

The warmest 7-day period of stream temperature daily maximums centered on: 07/21

7-day average maximum temperature (F.): 61.3

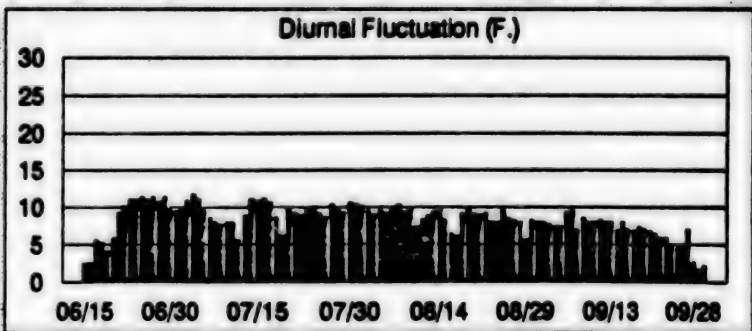
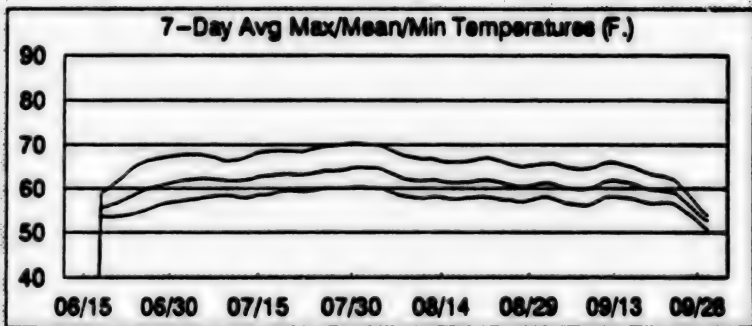
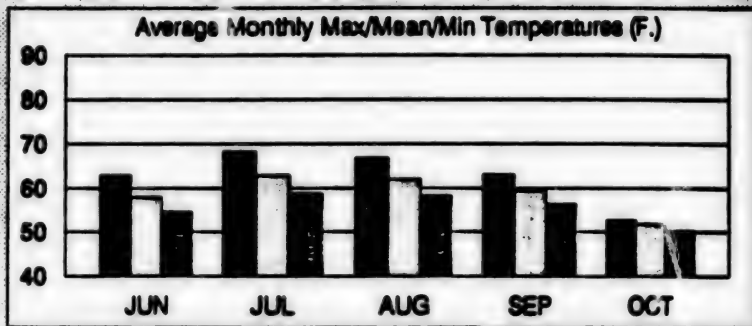
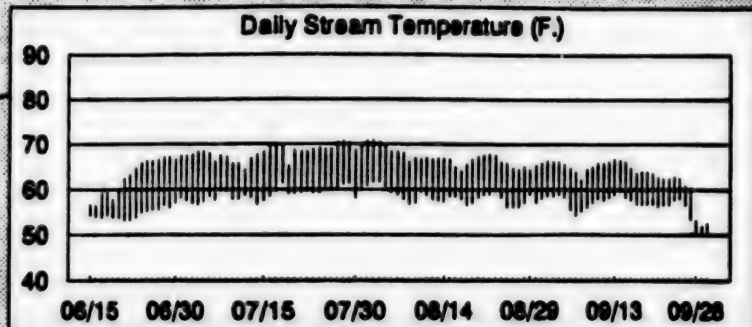
Daily Statistics for this period:

	07/18	07/19	07/20	07/21	07/22	07/23	07/24
maximum (F.):	61.5	60.3	60.4	61.2	61.7	61.9	62.1
minimum (F.):	58.5	58.8	58.6	58.4	58.2	58.7	60.3
mean (F.):	59.5	59.7	59.5	60.3	60.3	60.8	61.0
diurnal fluctuation (F.):	3.1	1.4	1.8	1.8	2.5	2.2	1.8

Applegate River above Little Applegate River 1995

Stream Temperature Data
BLM Medford District Office, Site Code: UPAP

Monthly Statistics	JUN	JUL	AUG	SEP	OCT
<i>Days of complete data:</i>	18	31	31	30	8
<i>Daily Maximums (F.)</i>					
highest maximum:	67.3	70.8	71.1	66.7	62.8
lowest maximum:	58.4	64.4	64.1	61.9	62.8
average maximum:	62.9	68.3	68.8	63.0	62.7
days with maximums <60:	8	-	-	3	8
days with maximums 60-65:	3	1	6	17	-
days with maximums 65-70:	7	25	22	10	-
days with maximums >70:	-	5	3	-	-
days exceeding 64.0: (COEQ water quality standard)	8	31	31	14	-
<i>Daily minimums (F.)</i>					
highest minimum:	57.0	61.2	61.5	59.5	50.3
lowest minimum:	53.0	56.7	56.1	50.3	50.3
average minimum:	54.5	58.8	58.2	56.3	50.3
<i>Daily Means (F.)</i>					
highest mean:	61.3	65.4	65.9	62.9	51.9
lowest mean:	54.9	60.9	59.8	51.0	51.6
average mean:	57.9	62.8	62.0	59.4	51.7
<i>Daily diurnal fluctuation (F.)</i>					
highest diurnal fluctuation:	11.4	11.8	10.4	9.6	2.5
lowest diurnal fluctuation:	2.5	5.7	5.7	1.7	2.2
average diurnal fluctuation:	8.3	9.5	8.7	6.7	2.4
<i>7-day avg. maximums (F.)</i>					
highest 7-day avg. maximum:	67.3	70.4	70.3	66.0	62.6
lowest 7-day avg. maximum:	58.8	66.3	65.0	63.7	62.6
mean 7-day avg. maximum:	64.1	68.3	68.8	63.0	62.5
<i>7-day avg. minimums (F.)</i>					
highest 7-day avg. minimum:	56.7	60.5	60.4	58.2	50.3
lowest 7-day avg. minimum:	53.5	56.9	57.0	50.7	50.3
mean 7-day avg. minimum:	54.7	58.8	58.1	56.3	50.3
<i>7-day average means (F.)</i>					
highest 7-day avg. mean:	61.2	64.9	64.8	61.9	51.6
lowest 7-day avg. mean:	55.7	61.5	60.4	52.5	51.5
mean 7-day avg. mean:	58.5	62.9	62.0	59.4	51.6
<i>7-day average diurnal fluctuation (F.)</i>					
highest 7-day avg. mean:	11.2	10.6	9.8	8.4	2.3
lowest 7-day avg. mean:	5.0	7.9	7.6	3.0	2.3
mean 7-day avg. mean:	9.3	9.5	8.8	6.7	2.3



Statistics for the period of the 7-day Maximum

The warmest 7-day period of stream temperature daily maximums centered on: 07/31

7-day average maximum temperature (F.): 70.4

Daily Statistics for this period:

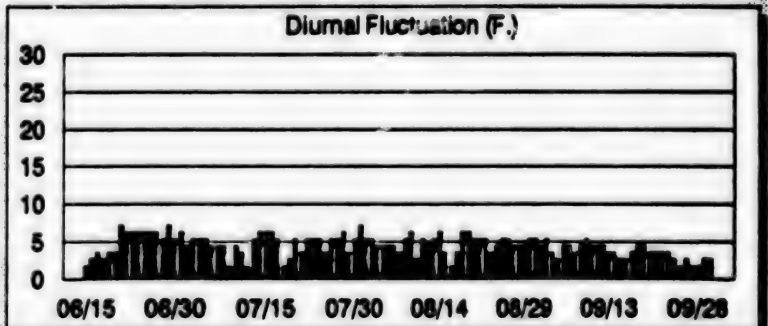
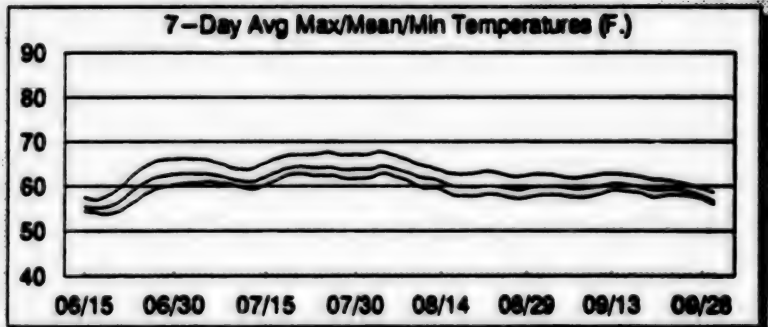
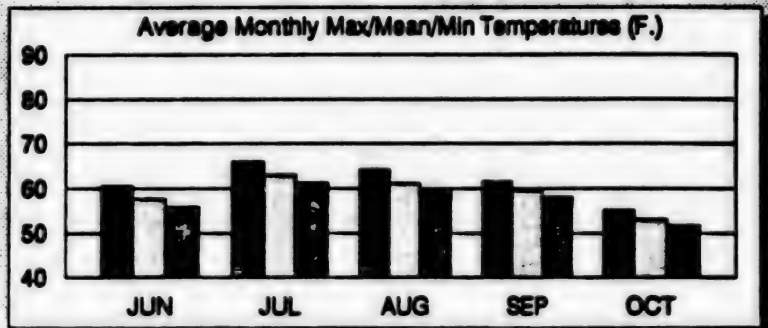
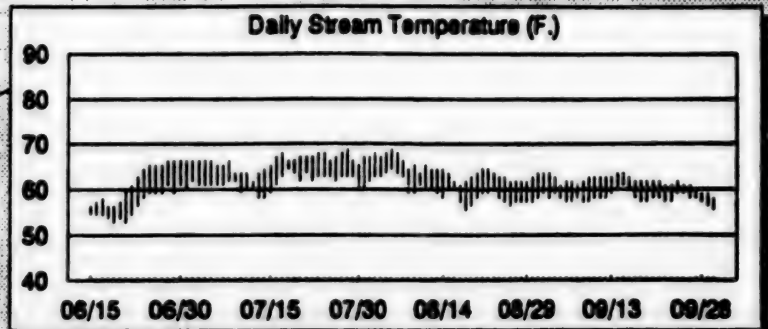
	07/28	07/29	07/30	07/31	08/01	08/02	08/03
maximum (F.):	70.8	70.5	68.7	70.2	70.8	71.1	70.5
minimum (F.):	60.8	61.2	58.1	59.8	60.8	61.5	61.5
mean (F.):	65.4	64.5	62.9	64.3	65.3	65.9	65.9
diurnal fluctuation (F.):	9.9	9.3	10.6	10.4	10.2	9.6	9.0

Star Gulch @ USGS Gaging Station, above Applegate River confluence 1995

Stream Temperature Data

BLM Medford District Office, Site Code: STRL

Monthly Statistics	JUN	JUL	AUG	SEP	OCT
<i>Days of complete data:</i>	30	31	31	30	14
<i>Daily Maximums (F.)</i>					
highest maximum:	66.2	66.9	66.9	63.5	58.1
lowest maximum:	55.4	61.7	60.8	58.1	52.7
average maximum:	60.5	66.0	64.2	61.6	55.1
days with maximums <60:	18	-	-	4	14
days with maximums 60-65:	8	6	22	28	-
days with maximums 65-70:	6	25	9	-	-
days with maximums >70:	-	-	-	-	-
days exceeding 64.0: (COEQ water quality standard)	7	26	15	-	-
<i>Daily minimums (F.)</i>					
highest minimum:	60.8	64.4	64.4	60.8	56.3
lowest minimum:	52.7	59.1	55.4	55.4	49.1
average minimum:	55.8	61.2	59.3	58.0	51.7
<i>Daily Means (F.)</i>					
highest mean:	62.6	65.3	65.3	61.7	56.3
lowest mean:	53.6	59.9	58.1	56.3	50.9
average mean:	57.7	63.0	61.2	58.5	53.0
<i>Daily diurnal fluctuation (F.)</i>					
highest diurnal fluctuation:	7.2	7.2	6.3	5.4	4.5
lowest diurnal fluctuation:	1.8	1.8	1.8	1.8	1.8
average diurnal fluctuation:	4.7	4.8	4.8	3.6	3.3
<i>7-day avg. maximums (F.)</i>					
highest 7-day avg. maximum:	66.1	67.6	67.7	62.9	57.8
lowest 7-day avg. maximum:	56.9	63.6	62.1	58.5	54.2
mean 7-day avg. maximum:	60.5	66.1	64.2	61.6	55.5
<i>7-day avg. minimums (F.)</i>					
highest 7-day avg. minimum:	60.3	62.9	63.0	59.1	55.0
lowest 7-day avg. minimum:	53.7	59.3	57.2	55.9	50.9
mean 7-day avg. minimum:	55.8	61.3	59.3	58.0	52.1
<i>7-day average means (F.)</i>					
highest 7-day avg. mean:	62.6	64.4	64.5	60.5	55.8
lowest 7-day avg. mean:	55.1	61.1	59.1	56.7	52.3
mean 7-day avg. mean:	57.7	63.0	61.2	59.4	53.4
<i>7-day average diurnal fluctuation (F.)</i>					
highest 7-day avg. mean:	6.4	5.7	5.3	4.5	3.9
lowest 7-day avg. mean:	2.8	3.6	4.2	2.2	2.8
mean 7-day avg. mean:	4.7	4.8	4.8	3.6	3.4



Statistics for the period of the 7-day Maximum

The warmest 7-day period of stream temperature daily maximums centered on: 08/03

7-day average maximum temperature (F.): 67.7

Daily Statistics for this period:

	07/31	08/01	08/02	08/03	08/04	08/05	08/06
maximum (F.):	67.1	67.1	68.0	67.1	66.0	66.9	66.0
minimum (F.):	59.9	61.7	62.8	62.8	63.5	64.4	63.5
mean (F.):	62.6	63.5	64.4	64.4	65.3	65.3	65.3
diurnal fluctuation (F.):	7.2	5.4	5.4	4.5	4.5	4.5	4.5

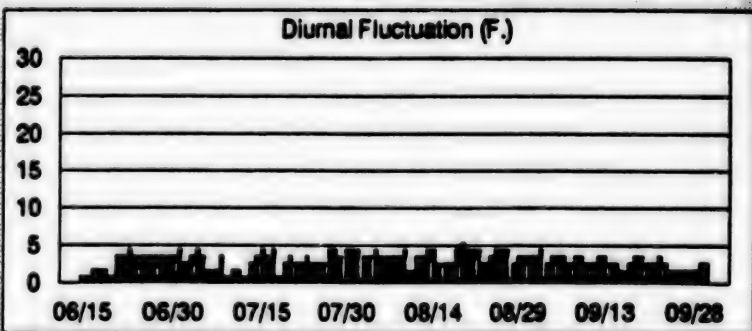
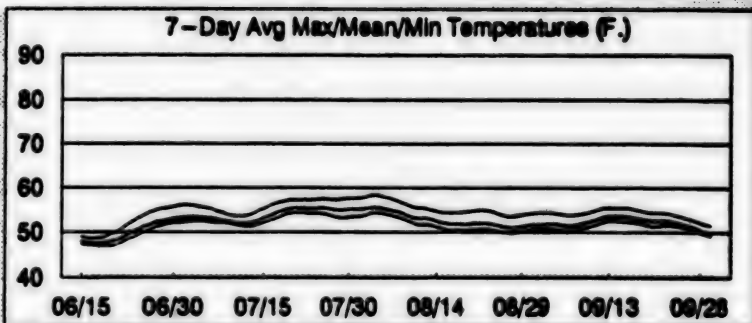
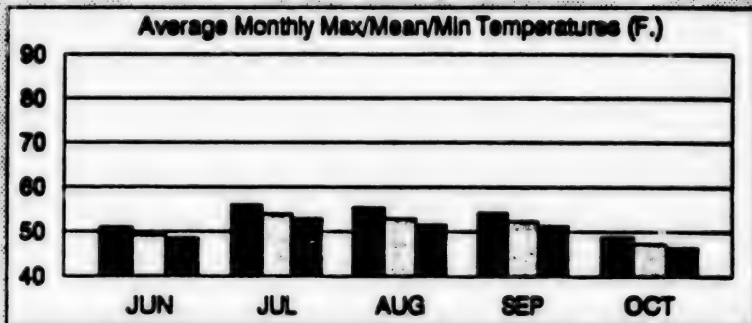
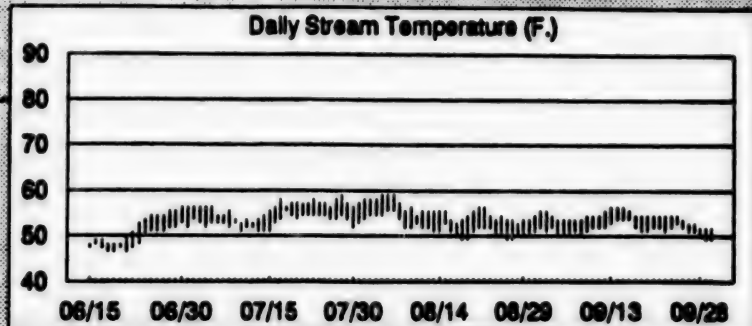
Star Gulch above Deadman Gulch

1995

Stream Temperature Data

BLM Medford District Office, Site Code: STRU

Monthly Statistics	JUN	JUL	AUG	SEP	OCT
Days of complete data:	30	31	31	30	14
Daily Maximums (F.)					
highest maximum:	56.3	56.0	56.0	56.3	50.9
lowest maximum:	47.3	52.7	52.7	51.6	47.3
average maximum:	51.1	56.1	55.4	54.2	48.6
days with maximums <60:	30	31	31	30	14
days with maximums 60-65:	-	-	-	-	-
days with maximums 65-70:	-	-	-	-	-
days with maximums >70:	-	-	-	-	-
days exceeding 64.0: (ODEQ water quality standard)	-	-	-	-	-
Daily minimums (F.)					
highest minimum:	52.7	55.4	55.4	53.6	49.1
lowest minimum:	46.4	50.9	49.1	49.1	44.6
average minimum:	48.5	53.0	51.6	51.3	46.5
Daily Means (F.)					
highest mean:	53.6	56.3	56.3	54.5	49.1
lowest mean:	46.4	51.8	50.9	50.0	45.5
average mean:	49.3	54.0	52.9	52.3	47.3
Daily diurnal fluctuation (F.)					
highest diurnal fluctuation:	4.5	4.5	5.4	4.5	2.7
lowest diurnal fluctuation:	0.9	0.9	1.8	1.8	1.8
average diurnal fluctuation:	2.6	3.1	3.8	2.9	2.3
7-day avg. maximums (F.)					
highest 7-day avg. maximum:	55.8	57.7	58.4	55.5	50.9
lowest 7-day avg. maximum:	48.6	53.7	53.6	51.5	48.3
mean 7-day avg. maximum:	51.1	56.1	55.4	54.2	49.1
7-day avg. minimums (F.)					
highest 7-day avg. minimum:	52.2	54.5	54.5	52.7	48.6
lowest 7-day avg. minimum:	47.0	51.4	49.7	49.2	46.0
mean 7-day avg. minimum:	48.5	53.0	51.6	51.3	46.6
7-day average means (F.)					
highest 7-day avg. mean:	53.1	55.4	55.7	53.7	49.2
lowest 7-day avg. mean:	47.6	52.1	51.0	49.7	46.6
mean 7-day avg. mean:	49.3	54.0	52.9	52.2	47.6
7-day average diurnal fluctuation (F.)					
highest 7-day avg. mean:	3.7	4.2	4.2	3.6	2.4
lowest 7-day avg. mean:	1.3	1.8	3.3	2.1	2.2
mean 7-day avg. mean:	2.5	3.1	3.8	2.9	2.3



Statistics for the period of the 7-day Maximum

The warmest 7-day period of stream temperature daily maximums centered on: 08/04

7-day average maximum temperature (F.): 58.4

Daily Statistics for this period:

	08/01	08/02	08/03	08/04	08/05	08/06	08/07
maximum (F.):	58.1	58.1	58.1	58.0	58.0	58.0	57.2
minimum (F.):	53.6	54.5	54.5	54.5	55.4	55.4	53.6
mean (F.):	55.4	55.4	55.4	56.3	56.3	56.3	54.5
diurnal fluctuation (F.):	4.5	3.6	3.6	4.5	3.6	3.6	3.6

8/17/95 - BLM MEDFORD - 58.4/54.5

Star Gulch above confluence with Applegate River, @ Gaging Station

1996

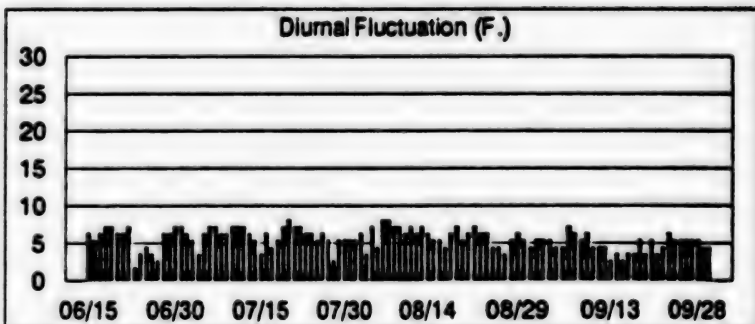
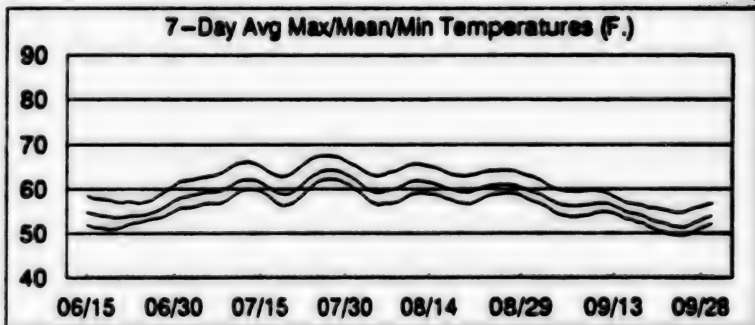
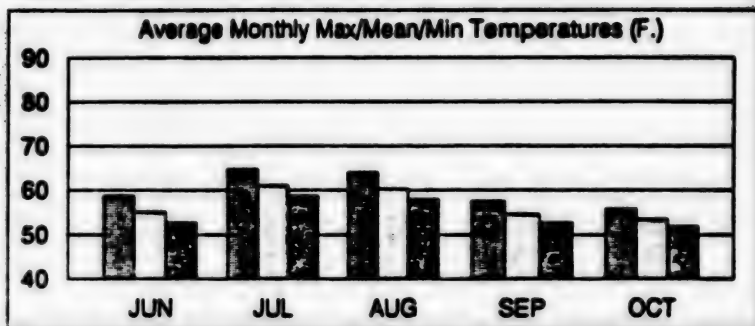
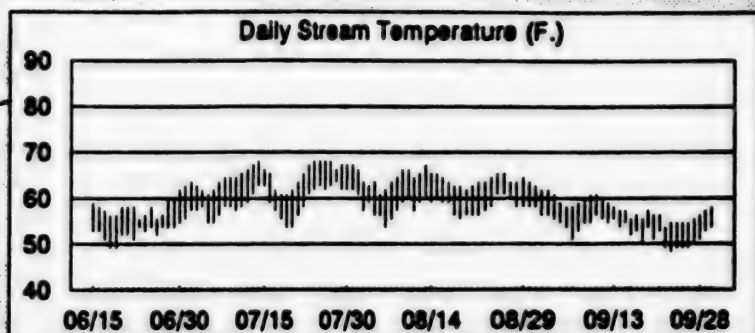
BLM Medford District

Stream Temperature Data for Site Code: STRL

Hydrologic Unit Code (HUC): 17 10 03 09 02 03 57

PROVISIONAL DATA SUBJECT TO REVISION

Monthly Statistics	JUN	JUL	AUG	SEP	OCT
<i>Days of complete data:</i>	30	31	31	30	14
<i>Daily Maximums (F.)</i>					
highest maximum:	61.7	66.0	67.1	61.7	57.2
lowest maximum:	55.4	60.8	60.8	53.6	51.6
average maximum:	58.7	64.8	64.0	57.6	55.8
days with maximums <60:	24	-	-	25	14
days with maximums 60-65:	6	15	22	5	-
days with maximums 65-70:	-	16	9	-	-
days with maximums >70:	-	-	-	-	-
7-day avg. maximums > 64.0 (CDEQ water quality standard)	-	18	15	-	-
<i>Daily minimums (F.)</i>					
highest minimum:	55.4	63.5	60.8	56.3	52.7
lowest minimum:	49.1	53.6	53.6	48.2	47.3
average minimum:	52.8	58.7	58.0	52.7	51.8
<i>Daily Means (F.)</i>					
highest mean:	58.1	64.4	62.6	58.1	54.5
lowest mean:	52.7	56.3	57.2	50.9	49.1
average mean:	55.2	61.1	60.4	54.7	53.5
<i>Daily diurnal fluctuation (F.)</i>					
highest diurnal fluctuation:	6.1	8.1	8.1	7.2	4.5
lowest diurnal fluctuation:	1.8	2.7	3.6	2.7	2.7
average diurnal fluctuation:	5.9	6.0	6.0	4.8	3.9
<i>7-day avg. maximums (F.)</i>					
highest 7-day avg. maximum:	60.9	67.5	65.7	62.0	58.9
lowest 7-day avg. maximum:	58.8	61.7	62.6	54.8	55.0
mean 7-day avg. maximum:	59.7	64.7	64.0	57.6	56.9
<i>7-day avg. minimums (F.)</i>					
highest 7-day avg. minimum:	55.0	62.2	59.8	56.7	52.8
lowest 7-day avg. minimum:	50.9	55.7	56.4	49.4	51.2
mean 7-day avg. minimum:	52.8	58.6	58.0	52.8	52.4
<i>7-day average means (F.)</i>					
highest 7-day avg. mean:	57.3	64.3	62.0	58.7	54.6
lowest 7-day avg. mean:	53.6	58.0	59.1	51.3	52.8
mean 7-day avg. mean:	55.2	60.9	60.4	54.7	54.0
<i>7-day average diurnal fluctuation (F.)</i>					
highest 7-day avg. fluctuation:	6.6	6.9	7.2	5.7	4.4
lowest 7-day avg. fluctuation:	4.1	4.9	4.9	3.6	3.7
mean 7-day avg. fluctuation:	5.9	6.0	6.0	4.8	3.9



Statistics for the period of the 7-day Maximum

The warmest 7-day period of stream temperature daily maximums centered on: 07/27

7-day average maximum temperature (F.): 67.5

Daily Statistics for this period:

	07/24	07/25	07/26	07/27	07/28	07/29	07/30
maximum (F.):	68.0	68.0	68.0	68.0	66.2	67.1	67.1
minimum (F.):	61.7	62.6	61.7	62.6	63.5	61.7	61.7
mean (F.):	63.5	64.4	64.4	64.4	64.4	64.4	64.4
diurnal fluctuation (F.):	6.3	5.4	6.3	5.4	2.7	5.4	5.4

Star Gulch above Benson Gulch

1996

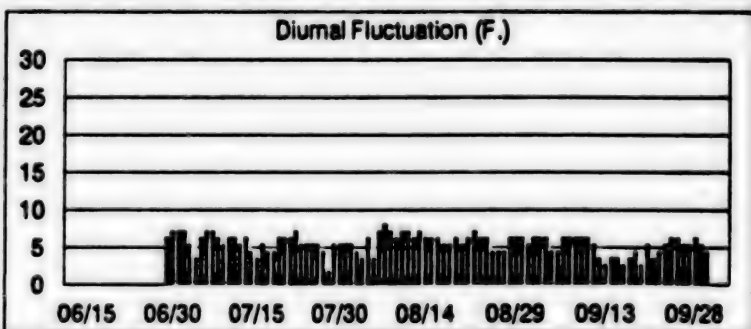
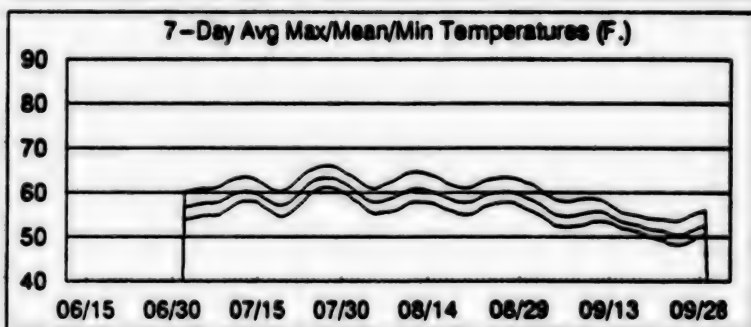
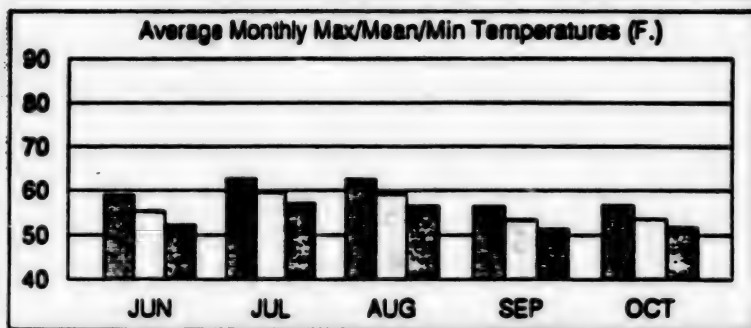
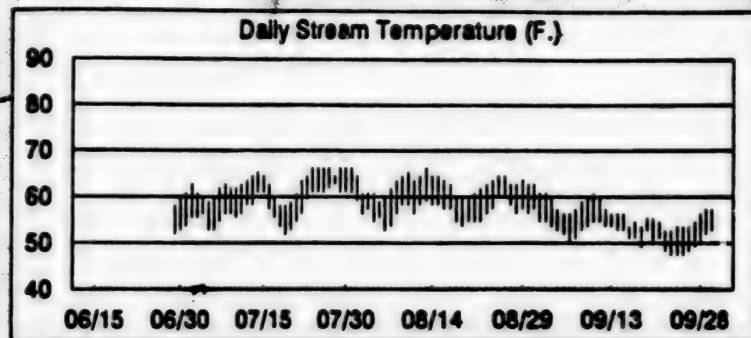
BLM Medford District

Stream Temperature Data for Site Code: STRB

Hydrologic Unit Code (HUC): 17 10 03 09 02 03 48

PROVISIONAL DATA SUBJECT TO REVISION

Monthly Statistics	JUN	JUL	AUG	SEP	OCT
Days of complete data:	2	31	31	30	2
Daily Maximums (F.)					
highest maximum:	60.0	66.2	66.2	60.8	57.2
lowest maximum:	58.1	58.1	58.0	52.7	56.3
average maximum:	59.0	62.7	62.6	56.4	56.6
days with maximums <60:	2	7	5	27	2
days with maximums 60-65:	-	18	24	3	-
days with maximums 65-70:	-	8	2	-	-
days with maximums >70:	-	-	-	-	-
7-day avg. maximums > 64.0 (ODEQ water quality standard)	-	8	5	-	-
Daily minimums (F.)					
highest minimum:	52.7	62.6	59.9	54.5	51.8
lowest minimum:	51.8	51.8	52.7	47.3	51.8
average minimum:	52.3	57.2	56.6	51.4	51.8
Daily Means (F.)					
highest mean:	56.3	63.5	61.7	57.2	53.6
lowest mean:	54.5	54.5	56.3	50.0	53.6
average mean:	55.4	59.6	59.2	53.5	53.6
Daily diurnal fluctuation (F.)					
highest diurnal fluctuation:	7.2	7.2	8.1	6.3	5.4
lowest diurnal fluctuation:	6.3	1.8	3.6	2.7	4.5
average diurnal fluctuation:	6.8	5.6	6.0	5.0	5.0
7-day avg. maximums (F.)					
highest 7-day avg. maximum:	-	65.9	64.7	61.1	-
lowest 7-day avg. maximum:	-	60.2	60.9	53.6	-
mean 7-day avg. maximum:	-	62.7	62.6	56.5	-
7-day avg. minimums (F.)					
highest 7-day avg. minimum:	-	61.2	58.5	55.1	-
lowest 7-day avg. minimum:	-	54.0	55.0	48.2	-
mean 7-day avg. minimum:	-	57.1	56.6	51.5	-
7-day average means (F.)					
highest 7-day avg. mean:	-	63.2	60.9	57.6	-
lowest 7-day avg. mean:	-	56.7	57.7	50.5	-
mean 7-day avg. mean:	-	59.5	59.2	53.5	-
7-day average diurnal fluctuation (F.)					
highest 7-day avg. fluctuation:	-	6.4	7.1	5.9	-
lowest 7-day avg. fluctuation:	-	4.5	4.9	3.3	-
mean 7-day avg. fluctuation:	-	5.5	6.0	5.0	-



Statistics for the period of the 7-day Maximum

The warmest 7-day period of stream temperature daily maximums centered on: 07/26

7-day average maximum temperature (F.): 65.9

Daily Statistics for this period:

	07/25	07/26	07/27	07/28	07/29	07/30	07/31
maximum (F.):	66.2	66.2	66.2	64.4	66.2	66.2	66.2
minimum (F.):	60.8	60.8	61.7	62.6	60.8	60.8	60.8
mean (F.):	63.5	63.5	63.5	63.5	62.6	63.5	62.6
diurnal fluctuation (F.):	5.4	5.4	4.5	1.8	5.4	5.4	5.4

Star Gulch above Lightning Gulch

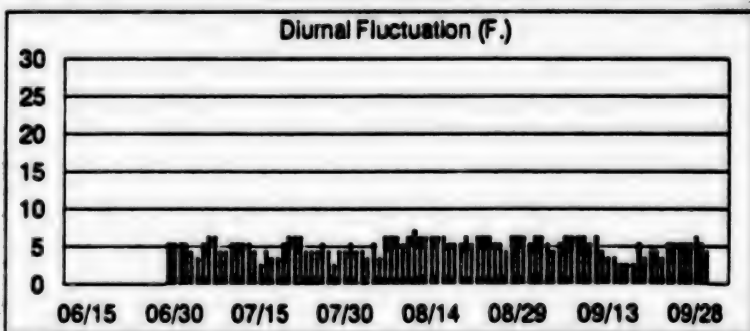
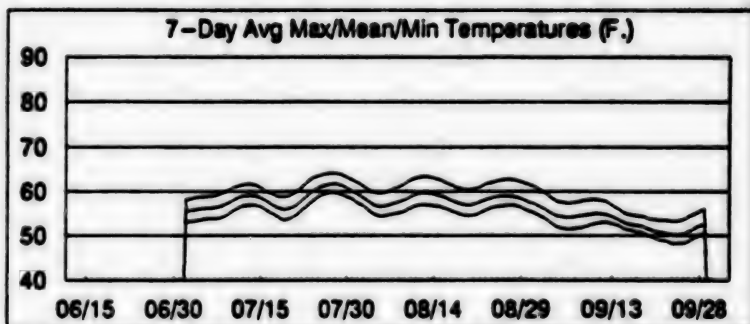
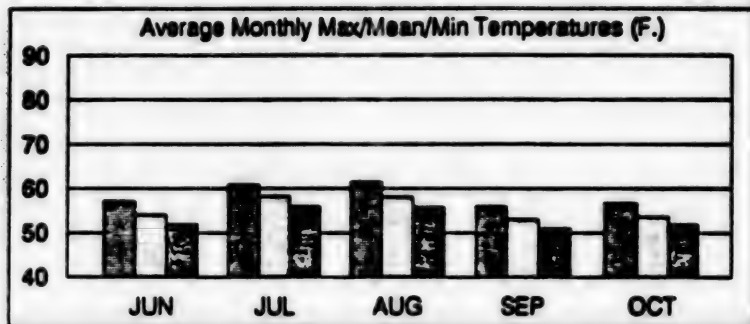
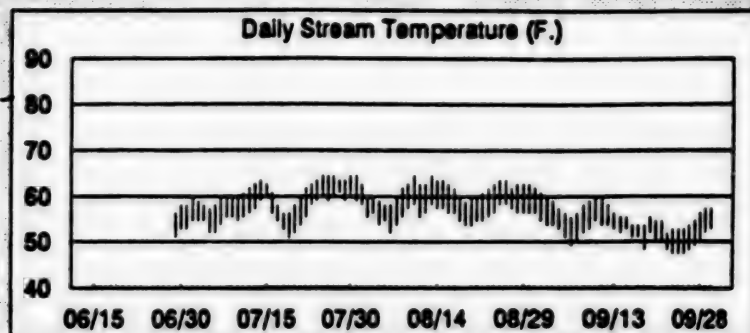
1996

BLM Medford District

Stream Temperature Data for Site Code: STLT
Hydrologic Unit Code (HUC): 17 10 03 09 02 03 42

PROVISIONAL DATA SUBJECT TO REVISION

Monthly Statistics	JUN	JUL	AUG	SEP	OCT
<i>Days of complete data:</i>	2	31	31	30	2
<i>Daily Maximums (F.)</i>					
highest maximum:	58.1	64.4	64.4	60.8	57.2
lowest maximum:	56.3	58.3	58.1	51.8	56.3
average maximum:	57.2	60.9	61.6	58.0	58.8
days with maximums <60:	2	15	10	29	2
days with maximums 60-65:	-	16	21	1	-
days with maximums 65-70:	-	-	-	-	-
days with maximums >70:	-	-	-	-	-
7-day avg. maximums > 64.0 (ODEQ water quality standard)	-	2	-	-	-
<i>Daily minimums (F.)</i>					
highest minimum:	52.7	60.8	58.1	54.5	51.8
lowest minimum:	50.9	50.9	51.8	47.3	51.8
average minimum:	51.8	58.0	55.9	51.1	51.8
<i>Daily Means (F.)</i>					
highest mean:	64.5	61.7	60.8	58.3	53.6
lowest mean:	53.6	53.6	55.4	48.1	53.6
average mean:	54.1	58.2	58.1	53.0	53.6
<i>Daily diurnal fluctuation (F.)</i>					
highest diurnal fluctuation:	5.4	6.3	7.2	6.3	5.4
lowest diurnal fluctuation:	5.4	2.7	3.6	2.7	4.5
average diurnal fluctuation:	5.4	4.9	5.7	5.0	5.0
<i>7-day avg. maximums (F.)</i>					
highest 7-day avg. maximum:	-	64.1	63.4	60.5	-
lowest 7-day avg. maximum:	-	58.1	59.5	53.2	-
mean 7-day avg. maximum:	-	60.9	61.6	58.1	-
<i>7-day avg. minimums (F.)</i>					
highest 7-day avg. minimum:	-	59.8	57.3	54.8	-
lowest 7-day avg. minimum:	-	53.1	54.4	48.2	-
mean 7-day avg. minimum:	-	56.0	55.9	51.1	-
<i>7-day average means (F.)</i>					
highest 7-day avg. mean:	-	61.7	59.6	58.8	-
lowest 7-day avg. mean:	-	55.4	56.6	50.1	-
mean 7-day avg. mean:	-	58.2	58.2	53.1	-
<i>7-day average diurnal fluctuation (F.)</i>					
highest 7-day avg. fluctuation:	-	5.4	6.4	6.0	-
lowest 7-day avg. fluctuation:	-	4.2	4.5	3.5	-
mean 7-day avg. fluctuation:	-	4.9	5.7	5.0	-



Statistics for the period of the 7-day Maximum

The warmest 7-day period of stream temperature daily maximums centered on: 07/28

7-day average maximum temperature (F.): 64.1

Daily Statistics for this period:

	07/25	07/26	07/27	07/28	07/29	07/30	07/31
maximum (F.):	64.4	64.4	64.4	63.5	63.5	64.4	64.4
minimum (F.):	59.9	59.0	59.9	60.8	59.0	59.9	59.0
mean (F.):	61.7	61.7	61.7	61.7	61.7	61.7	61.7
diurnal fluctuation (F.):	4.5	5.4	4.5	2.7	4.5	4.5	5.4

Star Gulch above Ladybug Gulch

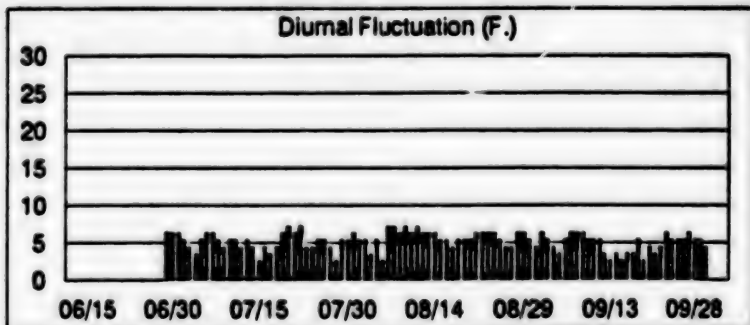
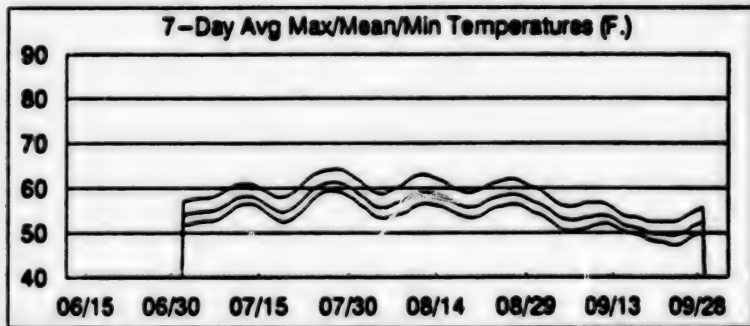
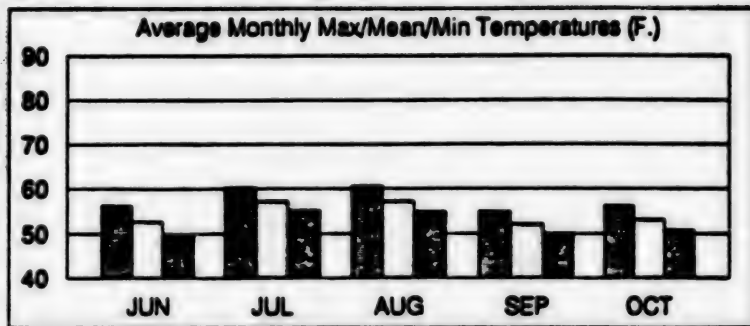
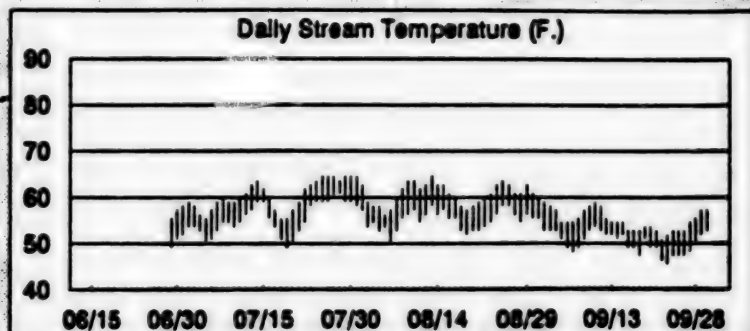
1996

BLM Medford District

Stream Temperature Data for Site Code: STLD
Hydrologic Unit Code (HUC): 17 10 03 09 02 03 18

PROVISIONAL DATA SUBJECT TO REVISION

Monthly Statistics	JUN	JUL	AUG	SEP	OCT
Days of complete data:	2	31	31	30	2
Daily Maximums (F.)					
highest maximum:	57.2	64.4	64.4	59.0	56.3
lowest maximum:	55.4	55.4	58.3	50.9	56.3
average maximum:	58.3	60.4	60.7	54.9	56.3
days with maximums <60:	2	17	13	30	2
days with maximums 60-65:	-	14	18	-	-
days with maximums 65-70:	-	-	-	-	-
days with maximums >70:	-	-	-	-	-
7-day avg. maximums > 64.0 (CDEQ water quality standard)	-	3	-	-	-
Daily minimums (F.)					
highest minimum:	50.9	60.8	58.1	53.6	50.9
lowest minimum:	49.1	49.1	50.0	45.5	50.9
average minimum:	50.0	55.2	55.0	50.1	50.9
Daily Means (F.)					
highest mean:	53.6	61.7	59.9	55.4	53.6
lowest mean:	51.8	51.8	53.6	48.2	52.7
average mean:	52.7	57.3	57.3	52.1	53.2
Daily diurnal fluctuation (F.)					
highest diurnal fluctuation:	6.3	7.2	7.2	6.3	5.4
lowest diurnal fluctuation:	6.3	2.7	2.7	2.7	5.4
average diurnal fluctuation:	6.3	5.1	5.7	4.8	5.4
7-day avg. maximums (F.)					
highest 7-day avg. maximum:	-	64.3	63.0	58.9	-
lowest 7-day avg. maximum:	-	57.1	58.6	52.4	-
mean 7-day avg. maximum:	-	60.3	60.7	54.9	-
7-day avg. minimums (F.)					
highest 7-day avg. minimum:	-	59.4	56.6	53.7	-
lowest 7-day avg. minimum:	-	51.7	53.2	47.3	-
mean 7-day avg. minimum:	-	55.2	55.0	50.1	-
7-day average means (F.)					
highest 7-day avg. mean:	-	61.3	59.1	55.9	-
lowest 7-day avg. mean:	-	54.0	55.5	49.5	-
mean 7-day avg. mean:	-	57.3	57.3	52.1	-
7-day average diurnal fluctuation (F.)					
highest 7-day avg. fluctuation:	-	5.9	6.8	5.8	-
lowest 7-day avg. fluctuation:	-	4.2	4.9	3.5	-
mean 7-day avg. fluctuation:	-	5.1	5.7	4.8	-



Statistics for the period of the 7-day Maximum

The warmest 7-day period of stream temperature daily maximums centered on: 07/28

7-day average maximum temperature (F.): 64.3

Daily Statistics for this period:

	07/25	07/26	07/27	07/28	07/29	07/30	07/31
maximum (F.):	64.4	64.4	64.4	63.5	64.4	64.4	64.4
minimum (F.):	59.0	59.0	59.9	60.8	59.0	59.0	58.1
mean (F.):	60.8	61.7	61.7	61.7	60.8	61.7	60.8
diurnal fluctuation (F.):	5.4	5.4	4.5	2.7	5.4	5.4	6.3

Star Gulch above Deadman Gulch

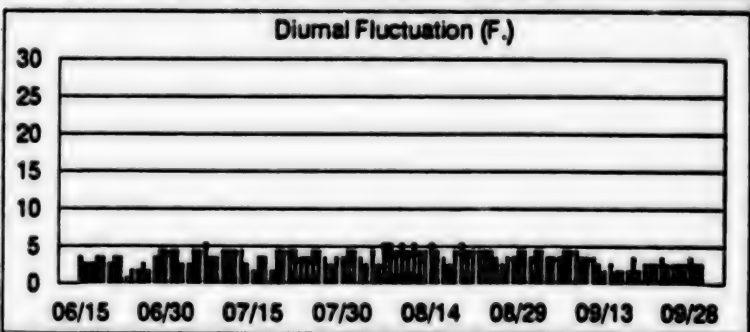
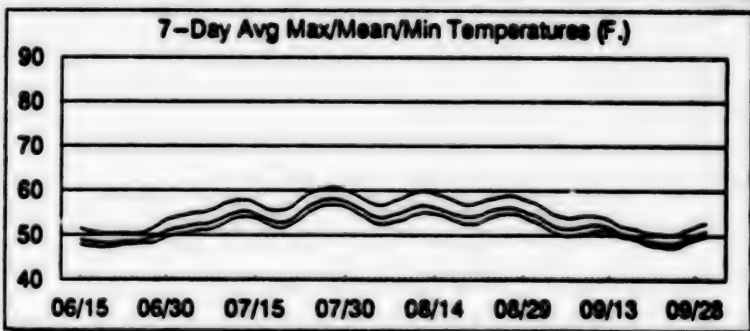
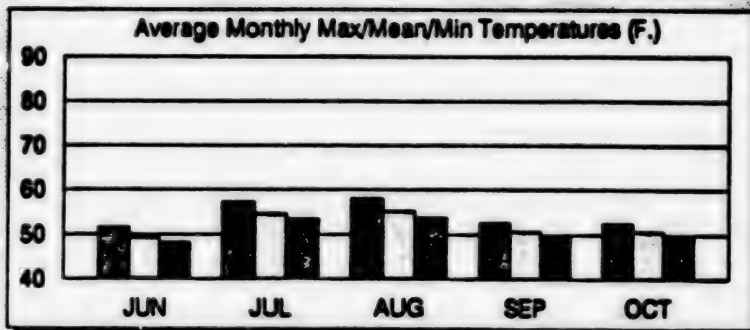
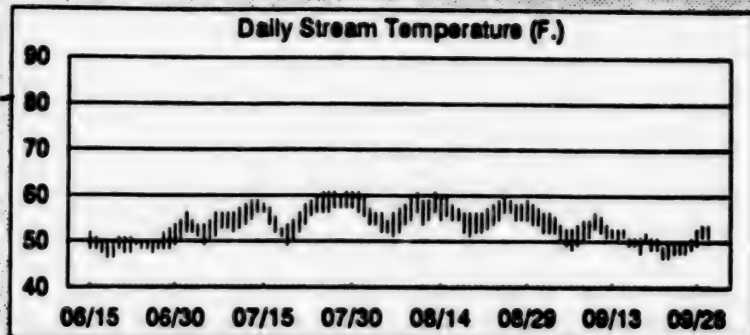
1996

BLM Medford District

Stream Temperature Data for Site Code: STRU
Hydrologic Unit Code (HUC): 17 10 03 06 02 03 03

PROVISIONAL DATA SUBJECT TO REVISION

Monthly Statistics	JUN	JUL	AUG	SEP	OCT
Days of complete data:	30	31	31	30	14
Daily Maximums (F.)					
highest maximum:	63.6	60.8	60.8	66.3	63.6
lowest maximum:	50.0	52.7	54.5	49.1	49.1
average maximum:	51.6	57.3	58.0	52.6	52.5
days with maximums <60:	30	26	29	30	14
days with maximums 60-65:	-	8	2	-	-
days with maximums 65-70:	-	-	-	-	-
days with maximums >70:	-	-	-	-	-
7-day avg. maximums > 64.0 (CDEQ water quality standard)	-	-	-	-	-
Daily minimums (F.)					
highest minimum:	50.0	57.2	58.3	52.7	50.9
lowest minimum:	48.4	48.1	50.9	46.4	46.4
average minimum:	48.2	53.4	53.8	49.5	49.8
Daily Means (F.)					
highest mean:	50.9	58.1	57.2	53.6	51.6
lowest mean:	47.3	50.9	52.7	47.3	47.3
average mean:	48.3	54.6	55.2	50.6	50.6
Daily diurnal fluctuation (F.)					
highest diurnal fluctuation:	4.6	5.4	5.4	4.6	3.6
lowest diurnal fluctuation:	0.9	1.8	2.7	1.8	1.8
average diurnal fluctuation:	3.4	3.9	4.3	3.1	2.7
7-day avg. maximums (F.)					
highest 7-day avg. maximum:	53.3	60.7	59.9	56.6	53.1
lowest 7-day avg. maximum:	50.3	53.9	56.6	50.1	52.1
mean 7-day avg. maximum:	51.6	57.1	58.1	52.7	52.9
7-day avg. minimums (F.)					
highest 7-day avg. minimum:	49.6	56.8	55.0	52.4	50.5
lowest 7-day avg. minimum:	47.2	50.0	52.4	47.3	49.4
mean 7-day avg. minimum:	48.2	53.3	53.8	49.6	50.2
7-day average means (F.)					
highest 7-day avg. mean:	50.9	58.1	56.6	54.0	51.3
lowest 7-day avg. mean:	48.3	51.3	53.9	48.2	50.3
mean 7-day avg. mean:	48.3	54.6	55.2	50.7	51.0
7-day average diurnal fluctuation (F.)					
highest 7-day avg. fluctuation:	4.1	4.4	5.0	4.1	2.8
lowest 7-day avg. fluctuation:	2.3	3.2	3.7	2.2	2.6
mean 7-day avg. fluctuation:	3.4	3.9	4.3	3.1	2.7



Statistics for the period of the 7-day Maximum

The warmest 7-day period of stream temperature daily maximums centered on: 07/26

7-day average maximum temperature (F.): 60.7

Daily Statistics for this period:

	07/25	07/26	07/27	07/28	07/29	07/30	07/31
maximum (F.):	60.8	60.8	60.8	59.9	60.6	60.8	60.8
minimum (F.):	56.3	56.3	57.2	57.2	57.2	57.2	58.3
mean (F.):	58.1	58.1	58.1	58.1	58.1	58.1	58.1
diurnal fluctuation (F.):	4.5	4.5	3.6	2.7	3.6	3.6	4.5

Alexander Gulch @ confluence with Star Gulch

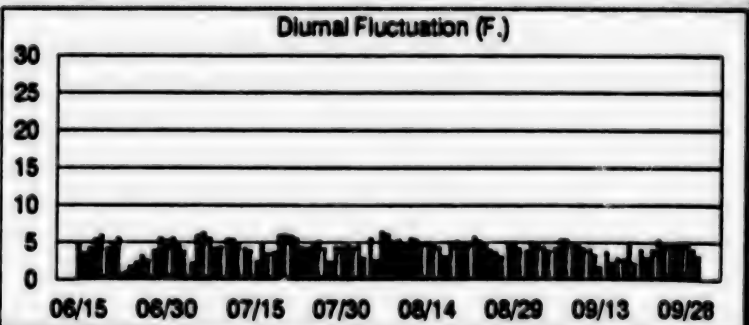
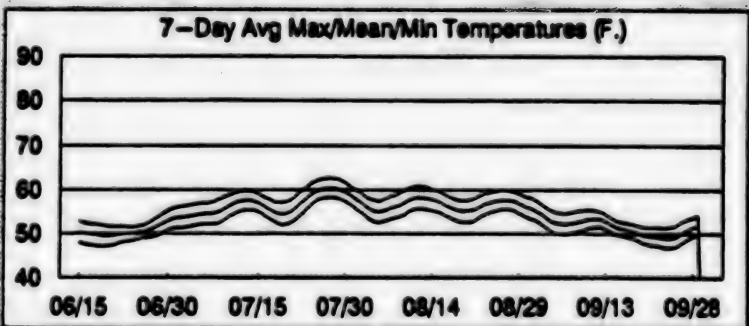
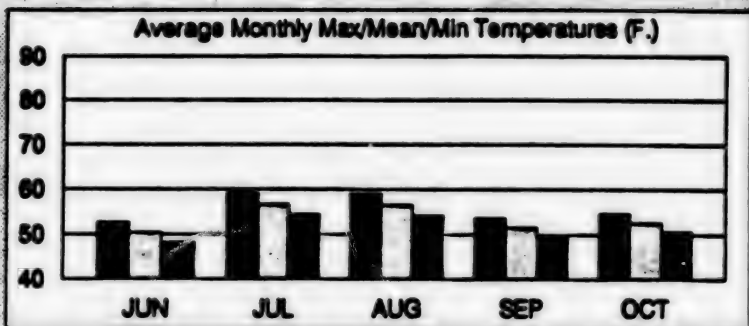
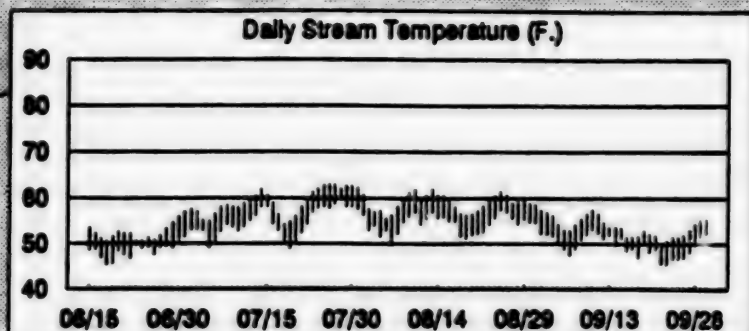
1996

BLM Medford District

Stream Temperature Data for Site Code: ALEX
Hydrologic Unit Code (HUC): 17 10 03 09 02 03 15

PROVISIONAL DATA SUBJECT TO REVISION

Monthly Statistics	JUN	JUL	AUG	SEP	OCT
<i>Days of complete data:</i>	20	31	31	30	2
<i>Daily Maximums (F.)</i>					
highest maximum:	55.9	63.0	61.9	57.4	54.9
lowest maximum:	50.7	54.3	55.6	49.9	54.5
average maximum:	52.6	59.2	59.0	53.7	54.7
days with maximums < 60:	20	19	20	30	2
days with maximums 60-65:	-	12	11	-	-
days with maximums 65-70:	-	-	-	-	-
days with maximums > 70:	-	-	-	-	-
7-day avg. maximums > 64.0 (COEQ water quality standard)	-	-	-	-	-
<i>Daily minimums (F.)</i>					
highest minimum:	50.7	59.5	57.2	53.1	50.7
lowest minimum:	45.3	48.9	49.6	45.3	50.5
average minimum:	48.3	54.5	54.2	49.5	50.6
<i>Daily Means (F.)</i>					
highest mean:	53.2	60.7	59.1	55.0	52.7
lowest mean:	48.0	51.8	53.0	47.8	52.5
average mean:	50.4	56.6	56.6	51.6	52.6
<i>Daily diurnal fluctuation (F.)</i>					
highest diurnal fluctuation:	6.1	6.3	6.5	5.4	4.1
lowest diurnal fluctuation:	1.1	2.3	2.7	1.8	4.0
average diurnal fluctuation:	4.3	4.7	4.8	4.1	4.1
<i>7-day avg. maximums (F.)</i>					
highest 7-day avg. maximum:	55.3	62.6	60.9	57.4	-
lowest 7-day avg. maximum:	51.5	55.8	57.4	51.3	-
mean 7-day avg. maximum:	52.5	59.0	59.0	53.7	-
<i>7-day avg. minimums (F.)</i>					
highest 7-day avg. minimum:	50.8	58.3	55.7	52.9	-
lowest 7-day avg. minimum:	47.0	51.3	52.6	46.8	-
mean 7-day avg. minimum:	48.4	54.3	54.2	49.8	-
<i>7-day average means (F.)</i>					
highest 7-day avg. mean:	53.0	60.3	58.2	55.1	-
lowest 7-day avg. mean:	49.5	53.6	55.0	49.0	-
mean 7-day avg. mean:	50.4	56.6	56.6	51.6	-
<i>7-day average diurnal fluctuation (F.)</i>					
highest 7-day avg. fluctuation:	4.9	5.3	5.6	4.6	-
lowest 7-day avg. fluctuation:	3.0	4.0	4.2	3.0	-
mean 7-day avg. fluctuation:	4.1	4.7	4.8	4.1	-



Statistics for the period of the 7-day Maximum

The warmest 7-day period of stream temperature daily maximums centered on: 07/28

7-day average maximum temperature (F.): 62.6

Daily Statistics for this period:

	07/25	07/26	07/27	07/28	07/29	07/30	07/31
maximum (F.):	62.6	63.0	63.0	62.1	62.6	62.6	62.2
minimum (F.):	56.1	57.7	58.6	59.5	58.1	58.1	57.8
mean (F.):	60.3	60.4	60.6	60.7	60.3	60.3	59.9
diurnal fluctuation (F.):	4.7	5.2	4.3	2.6	4.5	4.5	4.7

1996

Stream Temperature Data for Site Code: BENS
Hydrologic Unit Code (HUC): 17 10 03 09 02 03 51

Monthly Statistics	JUN	JUL	AUG	SEP	OCT
<i>Days of complete data:</i>	18	31	31	30	2
<i>Daily Maximums (F.)</i> highest maximum: lowest maximum: average maximum:	86.8 82.5 83.7	81.2 88.1 88.8	80.8 88.8 88.4	87.2 81.7 84.2	83.9 83.9 83.9
days with maximums <80: days with maximums 80-85: days with maximums 86-90: days with maximums >90:	18 - - -	21 10 - -	30 1 - -	30 - - -	2 - - -
7-day avg. maximums > 84.0 (CDEQ water quality standard)	-	-	-	-	-
<i>Daily minimums (F.)</i> highest minimum: lowest minimum: average minimum:	82.8 48.8 81.0	80.1 82.8 88.2	88.3 83.8 88.2	88.0 48.1 82.2	81.9 81.7 81.8
<i>Daily Means (F.)</i> highest mean: lowest mean: average mean:	84.3 80.8 82.4	80.5 84.5 87.4	88.8 85.5 87.4	88.3 80.8 83.3	82.9 82.9 82.9
<i>Daily diurnal fluctuation (F.)</i> highest diurnal fluctuation: lowest diurnal fluctuation: average diurnal fluctuation:	3.8 0.8 2.7	3.8 1.1 2.4	3.1 1.4 2.2	2.8 0.8 2.0	2.2 2.0 2.1
<i>7-day avg. maximums (F.)</i> highest 7-day avg. maximum: lowest 7-day avg. maximum: mean 7-day avg. maximum:	85.8 83.0 83.8	81.0 88.2 88.5	88.8 87.3 88.4	87.4 82.0 84.2	- - -
<i>7-day avg. minimums (F.)</i> highest 7-day avg. minimum: lowest 7-day avg. minimum: mean 7-day avg. minimum:	83.0 80.1 81.2	88.1 83.4 88.1	87.8 85.1 88.2	85.3 48.7 82.3	- - -
<i>7-day average means (F.)</i> highest 7-day avg. mean: lowest 7-day avg. mean: mean 7-day avg. mean:	84.3 81.7 82.5	80.1 84.8 87.3	88.0 88.4 87.4	88.5 80.8 83.3	- - -
<i>7-day average diurnal fluctuation (F.)</i> highest 7-day avg. fluctuation: lowest 7-day avg. fluctuation: mean 7-day avg. fluctuation:	3.2 1.8 2.5	3.0 1.8 2.5	2.8 1.8 2.2	2.4 1.4 2.0	- - -

	07/25	07/26	07/27	07/28	07/29	07/30	07/31
maximum (F.):	60.6	60.9	60.9	61.2	61.2	61.2	61.2
minimum (F.):	58.6	58.8	59.2	60.1	58.9	59.2	59.2
mean (F.):	59.6	59.8	60.1	60.5	60.1	60.3	60.2
diurnal fluctuation (F.):	2.0	2.3	1.7	1.1	2.3	2.0	2.0

1996

Stream Temperature Data for Site Code: DEAD
Hydrologic Unit Code (HUC): 17 10 03 00 02 03 00

Monthly Statistics	JUN	JUL	AUG	SEP	OCT
Days of complete data:	17	31	31	30	2
Daily Maximums (F.) highest maximum: lowest maximum: average maximum:	81.3 80.4 80.7	85.9 81.1 83.8	86.1 85.4 85.8	85.9 82.9 84.3	83.2 83.2 83.2
days with maximums <80: days with maximums 80-85: days with maximums 86-90: days with maximums >90:	17 - - -	31 - - -	31 - - -	30 - - -	2 - - -
7-day avg. maximums > 84.0 (DOE water quality standard)	-	-	-	-	-
Daily minimums (F.) highest minimum: lowest minimum: average minimum:	81.3 80.2 80.5	85.8 80.7 83.8	85.8 85.2 85.8	85.8 82.7 84.1	83.1 82.9 83.0
Daily Means (F.) highest mean: lowest mean: average mean:	81.3 80.2 80.6	85.8 81.0 83.7	85.9 85.3 85.7	85.8 82.7 84.2	83.2 83.0 83.1
Daily diurnal fluctuation (F.) highest diurnal fluctuation: lowest diurnal fluctuation: average diurnal fluctuation:	0.4 0.2 0.1	0.5 0.2 0.3	0.4 0.2 0.3	0.5 0.2 0.2	0.4 0.2 0.3
7-day avg. maximums (F.) highest 7-day avg. maximum: lowest 7-day avg. maximum: mean 7-day avg. maximum:	81.0 80.4 80.8	85.8 81.2 83.8	86.0 85.5 85.8	85.9 83.0 84.4	- - -
7-day avg. minimums (F.) highest 7-day avg. minimum: lowest 7-day avg. minimum: mean 7-day avg. minimum:	80.8 80.3 80.4	85.8 80.9 83.8	85.7 85.3 85.8	85.7 82.8 84.1	- - -
7-day average means (F.) highest 7-day avg. mean: lowest 7-day avg. mean: mean 7-day avg. mean:	80.8 80.3 80.5	85.7 81.1 83.7	85.8 85.4 85.7	85.8 82.8 84.3	- - -
7-day average diurnal fluctuation (F.) highest 7-day avg. fluctuation: lowest 7-day avg. fluctuation: mean 7-day avg. fluctuation:	0.3 0.3 0.3	0.4 0.2 0.3	0.4 0.2 0.3	0.3 0.2 0.3	- - -

Daily mean temperature (°C)

Date	Temperature (°C)
06/15	51
06/30	52
07/15	55
07/30	55
08/14	55
08/29	55
09/13	55
09/23	54

Month	Number of fish per 100 m²
JUN	50
JUL	53
AUG	56
SEP	54
OCT	53

The graph shows the average temperature of the water column in degrees Celsius. The y-axis ranges from 40 to 90 in increments of 10. The x-axis shows dates from 06/15 to 09/28. The temperature starts at 40°C on 06/15, rises to 50°C by 06/22, and then remains relatively stable, fluctuating between 50°C and 55°C until 09/28.

Date	Temperature (°C)
06/15	40
06/22	50
07/06	50
07/13	52
07/20	54
07/27	55
08/03	54
08/10	55
08/17	55
08/24	54
08/31	52
09/07	50
09/14	50
09/21	50
09/28	50

Date	Number of People
06/15	0
06/30	5
07/15	10
07/30	15
08/14	20
08/29	25
09/13	30
09/28	30

	08/27	08/28	08/29	08/30	08/31	09/01	09/02
maximum (F.):	\$6.9	\$6.1	\$6.1	\$6.1	\$6.1	\$5.9	\$5.9
minimum (F.):	\$5.6	\$5.8	\$5.8	\$5.8	\$5.8	\$5.8	\$5.8
mean (F.):	\$5.7	\$5.8	\$5.8	\$5.8	\$5.9	\$5.8	\$5.8
durnal fluctuation (F.):	0.4	0.4	0.4	0.4	0.4	0.4	0.3

Ladybug Gulch @ confluence with Star Gulch

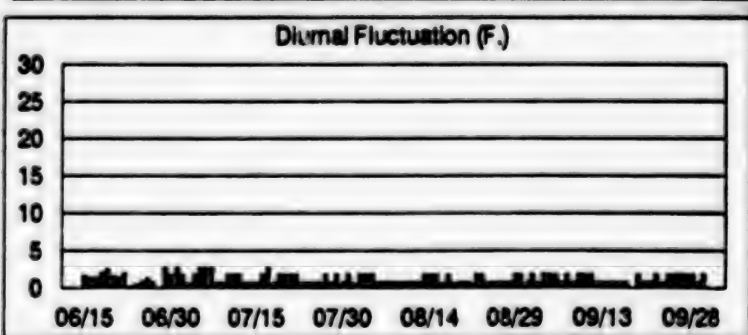
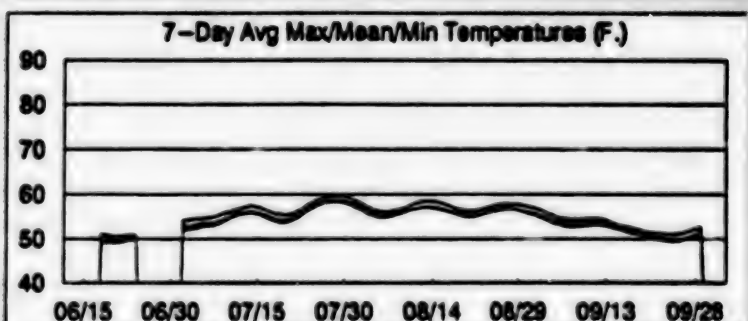
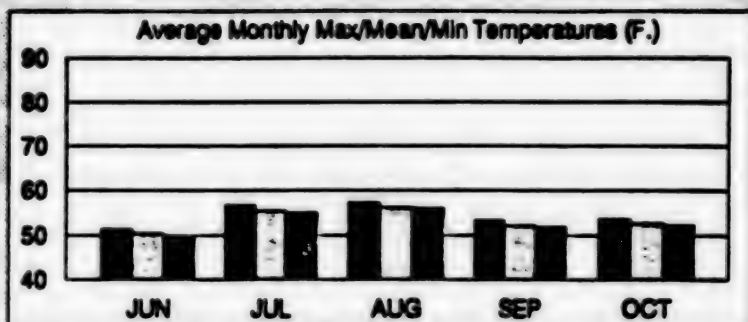
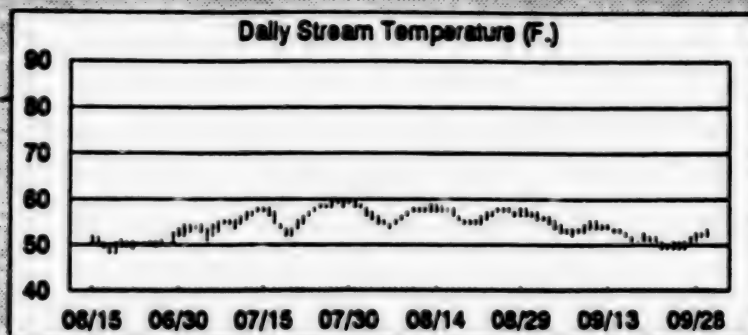
1996

BLM Medford District

Stream Temperature Data for Site Code: LADY
Hydrologic Unit Code (HUC): 17 10 03 09 02 03 21

PROVISIONAL DATA SUBJECT TO REVISION

Monthly Statistics	JUN	JUL	AUG	SEP	OCT
Days of complete data:	18	31	31	30	2
Daily Maximums (F.)					
highest maximum:	53.8	59.9	58.0	57.2	53.8
lowest maximum:	50.0	53.8	54.5	50.0	53.8
average maximum:	51.2	56.8	57.3	53.3	53.8
days with maximums <50:	18	31	31	30	2
days with maximums 50-55:	-	-	-	-	-
days with maximums 55-70:	-	-	-	-	-
days with maximums >70:	-	-	-	-	-
7-day avg. maximums > 54.0 (CDEQ water quality standard)	-	-	-	-	-
Daily minimums (F.)					
highest minimum:	51.8	58.0	58.1	55.4	52.7
lowest minimum:	49.1	50.9	53.8	49.1	51.8
average minimum:	49.7	55.1	56.0	51.9	52.3
Daily Means (F.)					
highest mean:	51.8	59.0	58.1	55.4	52.7
lowest mean:	49.2	51.8	53.8	49.1	52.7
average mean:	50.5	55.5	56.2	52.2	52.7
Daily diurnal fluctuation (F.)					
highest diurnal fluctuation:	2.7	2.7	1.8	1.8	1.8
lowest diurnal fluctuation:	0.3	0.9	0.9	0.9	0.9
average diurnal fluctuation:	1.5	1.8	1.2	1.4	1.4
7-day avg. maximums (F.)					
highest 7-day avg. maximum:	51.0	59.8	58.8	56.8	-
lowest 7-day avg. maximum:	50.7	54.0	56.0	51.0	-
mean 7-day avg. maximum:	50.8	56.7	57.3	53.3	-
7-day avg. minimums (F.)					
highest 7-day avg. minimum:	49.8	56.4	57.2	55.4	-
lowest 7-day avg. minimum:	49.1	51.8	54.9	49.5	-
mean 7-day avg. minimum:	49.4	55.1	56.0	52.0	-
7-day average means (F.)					
highest 7-day avg. mean:	50.4	58.8	57.7	55.7	-
lowest 7-day avg. mean:	50.0	52.8	55.1	49.9	-
mean 7-day avg. mean:	50.2	55.5	56.2	52.3	-
7-day average diurnal fluctuation (F.)					
highest 7-day avg. fluctuation:	1.8	2.2	1.5	1.7	-
lowest 7-day avg. fluctuation:	1.0	1.2	0.9	1.0	-
mean 7-day avg. fluctuation:	1.4	1.8	1.2	1.5	-



Statistics for the period of the 7-day Maximum

The warmest 7-day period of stream temperature daily maximums centered on: 07/29

7-day average maximum temperature (F.): 58.8

Daily Statistics for this period:

	07/26	07/27	07/28	07/29	07/30	07/31	08/01
maximum (F.):	59.0	59.9	59.9	59.9	59.9	59.9	59.0
minimum (F.):	56.1	56.1	56.0	56.1	56.0	56.1	56.1
mean (F.):	56.1	56.1	56.0	56.0	56.0	56.0	56.1
diurnal fluctuation (F.):	0.9	1.8	0.9	1.8	0.9	1.8	0.9

Lightning Gulch above confluence with Star Gulch

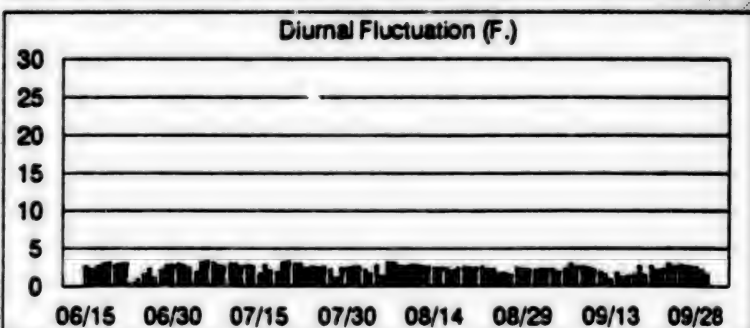
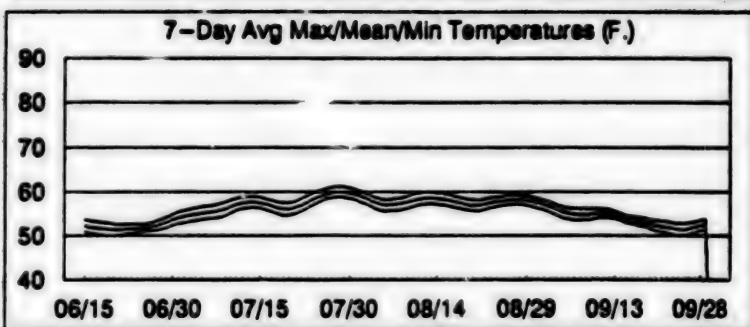
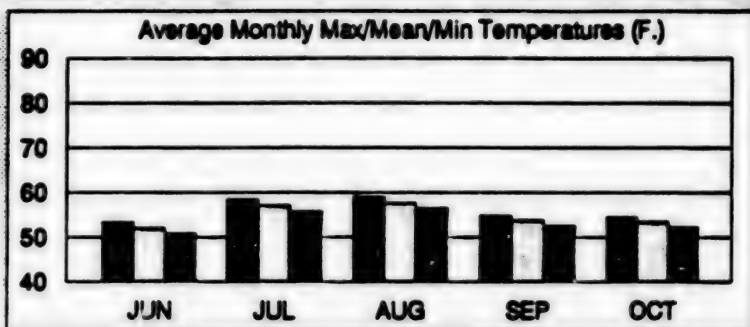
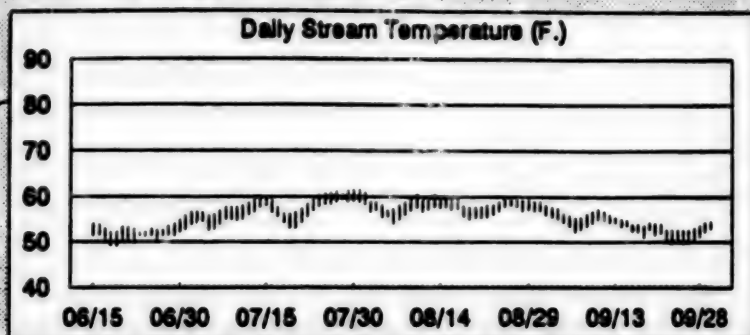
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BLM Medford District

Stream Temperature Data for Site Code: LITE
Hydrologic Unit Code (HUC): 17 10 03 09 02 33 45

PROVISIONAL DATA SUBJECT TO REVISION

Monthly Statistics	JUN	JUL	AUG	SEP	OCT
<i>Days of complete data:</i>	20	31	31	30	2
<i>Daily Maximums (F.)</i>					
highest maximum:	55.0	61.5	61.0	58.1	54.5
lowest maximum:	52.0	55.5	57.0	52.5	54.5
average maximum:	53.3	58.5	59.0	54.8	54.5
days with maximums <60:	20	22	27	30	2
days with maximums 60-65:	-	9	4	-	-
days with maximums 65-70:	-	-	-	-	-
days with maximums >70:	-	-	-	-	-
7-day avg. maximums > 64.0 (CDEQ water quality standard)	-	-	-	-	-
<i>Daily minimums (F.)</i>					
highest minimum:	52.2	59.4	58.3	55.8	52.3
lowest minimum:	49.9	52.5	54.0	49.5	52.3
average minimum:	50.8	55.8	56.5	52.6	52.3
<i>Daily Means (F.)</i>					
highest mean:	53.6	60.2	59.6	57.0	53.4
lowest mean:	50.7	54.2	55.7	51.0	53.4
average mean:	52.1	57.1	57.8	53.8	53.4
<i>Daily diurnal fluctuation (F.)</i>					
highest diurnal fluctuation:	3.2	3.4	3.2	3.1	2.2
lowest diurnal fluctuation:	0.5	1.3	1.4	1.1	2.2
average diurnal fluctuation:	2.5	2.7	2.5	2.2	2.2
<i>7-day avg. maximums (F.)</i>					
highest 7-day avg. maximum:	54.9	61.2	60.2	58.1	-
lowest 7-day avg. maximum:	52.5	55.5	58.1	52.8	-
mean 7-day avg. maximum:	53.2	58.4	59.0	54.9	-
<i>7-day avg. minimums (F.)</i>					
highest 7-day avg. minimum:	52.4	58.8	57.7	55.9	-
lowest 7-day avg. minimum:	50.0	52.9	55.8	50.1	-
mean 7-day avg. minimum:	50.8	55.7	56.5	52.7	-
<i>7-day average means (F.)</i>					
highest 7-day avg. mean:	53.6	59.9	59.0	57.1	-
lowest 7-day avg. mean:	51.4	54.1	55.9	51.4	-
mean 7-day avg. mean:	52.0	57.1	57.8	53.8	-
<i>7-day average diurnal fluctuation (F.)</i>					
highest 7-day avg. fluctuation:	2.9	3.1	2.9	2.7	-
lowest 7-day avg. fluctuation:	1.7	2.3	2.1	1.5	-
mean 7-day avg. fluctuation:	2.4	2.7	2.5	2.2	-



Statistics for the period of the 7-day Maximum

The warmest 7-day period of stream temperature daily maximums centered on: 07/29

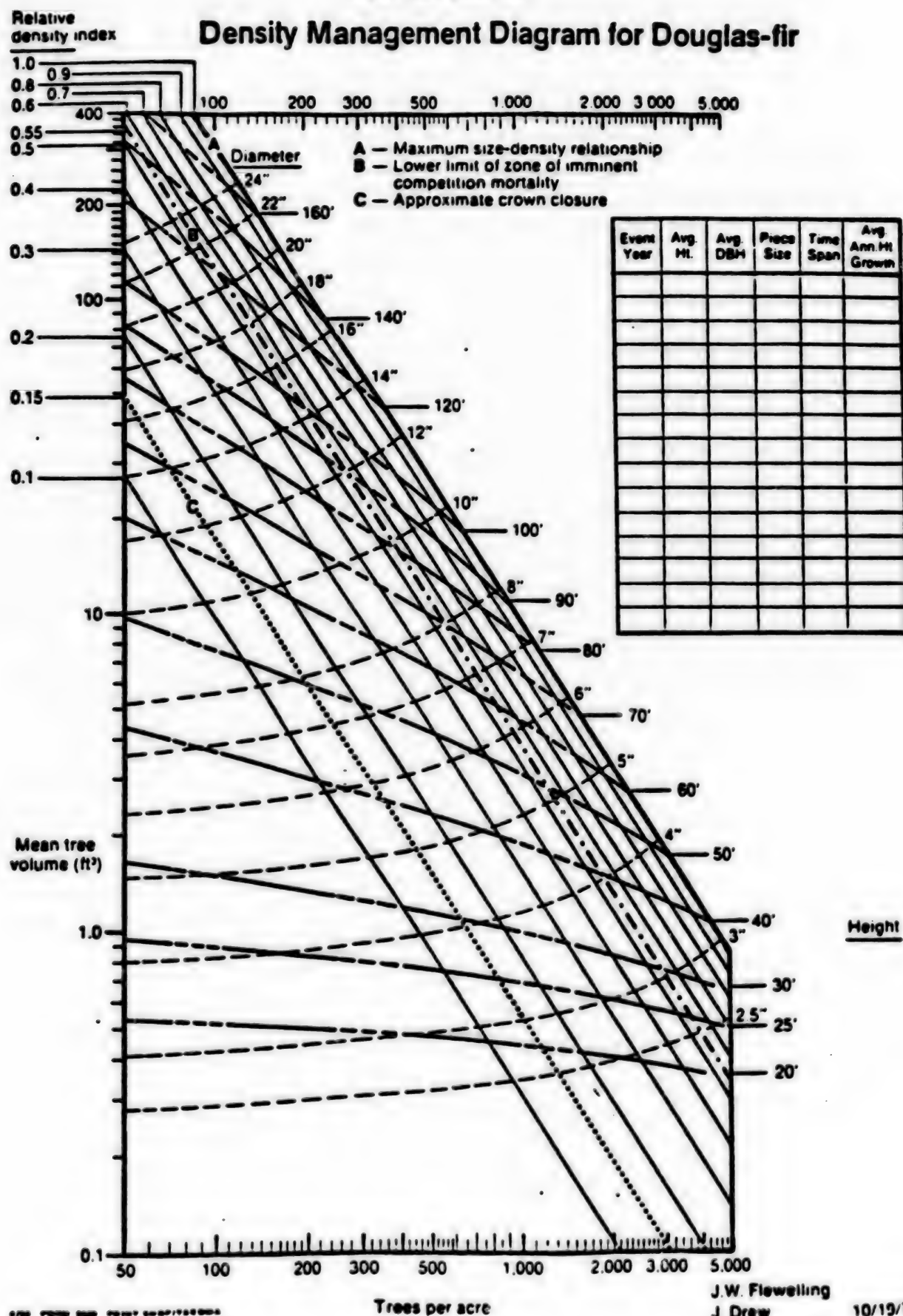
7-day average maximum temperature (F.): 61.2

Daily Statistics for this period:

	07/26	07/27	07/28	07/29	07/30	07/31	08/01
maximum (F.):	61.0	61.2	60.8	61.3	61.5	61.5	61.0
minimum (F.):	58.3	58.8	58.4	58.8	59.0	58.8	58.3
mean (F.):	59.7	59.9	59.9	60.0	60.2	60.2	59.8
diurnal fluctuation (F.):	2.7	2.3	1.3	2.5	2.5	2.7	2.7

APPENDIX C

Density Management Diagram for Douglas-fir



APPENDIX D

Process for Determining 15 Percent Late-Successional Retention Areas in the Star/Beaver/Palmer Fifth Field Watershed

The Northwest Forest Plan includes a standard and guideline that states "Landscape areas where little late-successional forest persists should be managed to retain late-successional patches. This standard and guideline will be applied in fifth field watersheds in which federal forest lands are currently comprised of 15 percent or less late-successional forest. This assessment should include all allocations in the watershed. Within such an area, all remaining late-successional stands should be protected. In Adaptive Management Areas, less than 15 percent of federal forest land in fifth field watershed in late-successional forest should be considered as a threshold for analysis rather than a strict standard and guideline" (pages C-44 and C-45).

Several members of the Applegate-Star/Boaz Watershed Analysis Team met four times with personnel from the U.S. Forest Service Applegate Ranger District between June 1996 and December 1996 to define and map late-successional forests to be managed for retention in the Star/Beaver/Palmer fifth field watershed.

Group discussions included the following agreements:

- Stands less than five acres should not be considered in determining late-successional areas.
- Late-successional retention should be determined by starting with the old growth and adding mature stands if necessary to reach 15 percent.
- The majority of the Survey and Manage species in this fifth field watershed to be protected through the retention of late-successional forests are plants rather than wildlife.
- Criteria for determining late-successional forest should include canopy closure, tree diameter, plant series, and dead and down material. We do not have any inventory of dead and down material for this watershed.
- The pine series needs to be included in the late-successional retention areas and a provision needs to be included that would allow one more commercial treatment to get the stand into late-successional condition.
- Start with a criteria of 21" + dbh and 60 percent canopy closure for Douglas-fir and 21" + dbh in the overstory (no canopy closure criteria) for ponderosa pine.
- In order to recognize the importance of habitat distribution, the group decided to identify 15 percent late-successional habitat in each subwatershed (i.e., Star, Palmer, and Beaver) to come up with a total of 15 percent for the fifth field watershed. (The Applegate-Star/Boaz Analysis Area includes the Applegate-Star Subwatershed plus some lands in the Beaver Creek Subwatershed.)

The Applegate-Star/Boaz Watershed Analysis Team identified areas to be included as 15 percent late-successional retention for the Applegate-Star Subwatershed and the Forest Service did the same for the Palmer and Beaver subwatersheds.

Priority areas identified for inclusion in the 15 percent late-successional retention for the Applegate-Star Subwatershed were reserve areas (spotted owl core areas and Riparian Reserves), *cypripedium* sites, areas that make logical connections to the Riparian Reserves, and Douglas-fir and ponderosa pine stands that are in old growth/mature stands. Total federal forest land in the Applegate-Star Subwatershed amounts to 10,266 acres. Fifteen percent of this equals 1,540 acres. Acreage in the designated old growth/mature stands totaled 1,619 acres or 15.8 percent of the federal forest land.

Late-successional habitat amounts to about 9 percent in Palmer Subwatershed and 14.9 percent in Beaver Subwatershed. This habitat includes the spotted owl core areas. To come up with 15 percent late-successional retention for each subwatershed, the Forest Service added areas from the next stand age that was as close to late-successional as possible. Salamander habitat was included in the area designated as late-successional retention.

Map 23 displays the 15 percent late-successional retention areas for the Star/Beaver/Palmer fifth field watershed.

APPENDIX E

UNITED STATES DEPARTMENT OF THE INTERIOR BUREAU OF LAND MANAGEMENT

Oregon State Office
P.O. Box 2965
Portland, Oregon 97208

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EMS TRANSMISSION 11/20/96
Information Bulletin No. OR-97-064

To: District Managers: Coos Bay, Eugene, Lakeview, Medford, Roseburg, and Salem

From: State Director

Subject: Implementation of Coarse Woody Debris Standards and Guidelines

Instruction Memorandum No. OR-95-028 dated November 29, 1994, provided guidance for the implementation within Matrix management lands of coarse woody debris (CWD) Standards and Guidelines (S&Gs) (pp. C-40 and 41 of the Northwest Forest Plan). As we continue to gain experience working with CWD on the ground, various prescriptions have been developed and clarifications requested for their use.

This Information Bulletin discusses options and clarification for the following CWD features:

- Retention of existing CWD;
- Crediting linear feet of logs;
- Crediting of large diameter short piece (less than 16/20 feet) logs by using a cubic foot equivalency alternative;
- Standing tree CWD retention versus felling to provide CWD substrate;
- Application of the basic guideline in areas of partial harvest.

The information contained in this bulletin may be used for the design and layout of Matrix harvest sales; however, proposed timber sales where layout has been completed need not be modified. Resource Management Plans may limit the implementation of some of these recommendations. This Information Bulletin has been shared widely with other agency specialists and a copy has been provided to the Regional Ecosystem Office (REO). We are forwarding the attached discussion paper for information and detail on how various resource areas have dealt with CWD issues.

The development of models for groups of plant associations and stand types to be used as a baseline for prescriptions within specific geographic areas is encouraged (S&Gs at C-40).

Part A, and C-41, Part E). The desired conditions should address both sustainable ecological and biological conditions, even providing habitat beyond natural conditions. Some working "CWD" and "desirable condition" definitions are given in the Appendix: historical ecological condition, species-specific biological condition, and desired future condition. Taking advantage of opportunities "to provide coarse woody debris well-distributed across the landscape in a manner which meets the needs of species and provides for ecological functions" should be captured in your local prescriptions.

If you have any additional questions, please contact Larry Larsen at 503-952-6080 or Nancy Anderson at 503-952-6072.

Signed by
A. Barron Bail
Acting Deputy State Director for
Resource Planning, Use & Protection

Authenticated by
Maggie Weaver
Management Asst.

1 Attachment

- 1 - Questions & discussion re S&Gs
for coarse woody debris (8 pp)

Distribution

WO-330 (Room 204 LS) - 1
OR-930 - 1
REO (Knowles, Pietrzak) - 2

Questions and Discussion Regarding Standards and Guidelines to Provide specified amounts of coarse woody debris in matrix management.

This paper discusses the implementation of the Standard and Guideline (S&G) titled "*Provide specified amounts of coarse woody debris [CWD] in matrix management*" (S&G C-40 and C-41). The S&G prescribed specific measures (S&G C-40, Part B) which need to be used until geographic guidelines are developed (S&G C-40, Parts A and E). As local knowledge on how best to design timber sales continues to increase, the ways to achieve adequate quantities of CWD are also developing. We have drafted a question-and-answer discussion paper which we believe will be helpful in your implementation of this S&G.

1. QUESTION: Retention and protection of CWD already on the ground was not addressed in Instruction Memorandum No. OR-95-028. Standard and Guideline C-40, Part C, states: "Coarse woody debris already on the ground should be retained and protected to the greatest extent possible from disturbance during treatment which might destroy the integrity of the substrate." Is the priority "to provide" CWD or "to retain" existing CWD? Is it appropriate to remove decay classes 1 and 2 and replace them? How limiting is "protect to the greatest extent possible?" Is the presence or absence of bark, post-logging, the critical indicator of functioning decay class 1 or 2 logs?

DISCUSSION: Logs present on the forest floor prior to harvest generally are providing habitat benefits that will likely continue after harvest. Where practicable, pre-harvest CWD decay class 1 and 2 logs should be reserved (e.g., painted with the reserve color) in adequate quantities to provide the baseline feet requirement; other decay class logs are to be protected to the extent possible. Specified amounts of decay class 1 and 2 logs to be retained is given in C-40, Part B; and suggested locations of retention areas is given in C-41, Part D.

The phrase "protected to the greatest extent possible" recognizes felling, yarding, slash treatments, and forest canopy openings will disturb CWD substrate and their dependent organisms. These disturbances should not cause substrates to be removed from the logging area nor should they curtail treatments. Appropriate protective practices should be addressed during logging design such as locating forest patches to retain logs, use of site preparation techniques, and attention to CWD during contract administration to minimize damage and protect substrate integrity. As a general rule, a reserve clause would be used in the timber sale contract and site preparation activities would be designed to minimize disturbance for all decay classes. During contract administration, our desire to protect these logs to the greatest extent possible should be conveyed to the purchaser.

Following harvest, coarse woody debris should be retained both for the current forest habitat and for the development and function of the next forest. Prescriptions should account for current habitat conditions and the timing and development of subsequent snags and CWD until the next stand once again begins to contribute CWD. Decay

substrates as a group generally persist for hundreds of years. Some CWD last up to 500 years within some forest ecosystems, while in others the life span is as short as 60 years. Advanced decayed material often holds large amounts of water and nutrients and contains the majority of soil horizon ectomycorrhizae. Prescriptions are to provide CWD to a full array of late-successional related species and to ensure soil organic material replacement over the next 100 years.

Prior to removal of any decay class 1 or 2 logs, the Interdisciplinary Team should evaluate the "appropriate coarse woody debris quantity, quality (such as species, decay stage and size) and distribution." Down logs should reflect the species composition of the original stand in order to retain the habitat conditions which would have occurred without harvest. The removal of excess decay class 1 and 2 logs is contingent upon the evidence of appropriately retained or provided amounts of decay class 1 and 2 logs. Large amounts of CWD are naturally and periodically infused into the forest following fires, blowdown, and snow/rain events and provide benefits to late-successional species. "Salvage" of these materials must provide for adequate levels of desirable biological substrates.

The presence or absence of bark has been used as a method to help logging crews distinguish between decay class 2 and 3 logs. Experience has indicated that some surface bark will be dislodged from CWD during felling, yarding, and site preparation. The presence or absence of bark is an important indicator, but not the sole critical indicator. (See structural features associated with decay class logs as given in the Forest Survey Handbook H-5250-1, "A five-class system of log decomposition based on fallen Douglas-fir trees," pp. IV-13/-16. In discussing site preparation, Graham et al. (1994) concluded that fire which charred bark and wood did not interfere substantially with the decomposition or function of CWD.) (Graham, et al., Managing Coarse Woody Debris in Forests of the Rocky Mountains. USDA Res Paper INT-RP-477. 1994.)

Cedar logs, whose wood texture remains decay class 2 for extended periods, tend to accumulate over time. They also tend to lose their bark when, as substrate, they still exhibit decay class 1 or 2 habitat features of structure and texture (i.e., buckskin logs); and their function is that of a decay class 1 or 2 log although bark retention is analogous to that of decay class 3 logs. Post-logging retention, or the removal, of some of these barkless logs is not expected to be critical to the overall function of CWD within a sale unit.

2. **QUESTION:** Specific amounts of decay class 1 and 2 logs are required following regeneration harvest (S&G C-40, Part B); and in crediting linear feet per acre, Instruction Memorandum No. OR-95-028 stated minimum diameter logs may be measured at the large end. For minimum diameter logs, what length can be credited as a piece to meet the linear feet CWD requirement?

DISCUSSION: In the case of minimum diameter-sized logs (16 or 20 inches at the large end), one minimum piece length (16 or 20-foot section) beyond the minimum diameter may be credited. Bucking tree lengths into sections is not the intent of this clarification or the S&G; long log lengths are preferable.

3. **QUESTION:** Large diameter, short piece length decay class 1 and 2 logs are being removed from units; and small diameter, adequate length logs are being retained. Can a volume equivalent to 20 inches x 20 feet, (i.e., logs greater than 40 cubic feet) be used to retain large diameter piece logs by crediting their footage toward meeting the linear feet of logs per acre requirement? (See Table 1)

DISCUSSION: An appropriate quantity and quality of CWD must be provided, and the specific measure states "Logs less than 20 [or 16] feet cannot be credited toward this [required minimum] total" (S&G C-40, Part B). Lacking those logs, the general rule is to retain the best material available.

We believe the specific measures are a baseline. We can use the specific measure to develop prescriptions for the retention of CWD. Larger CWD is important for the development and function of both the current and next forest; and because large diameter pieces of CWD have more durable heartwood than small pieces, they last longer. Large logs are a key habitat component for many forms of wildlife; and by disrupting air flow and providing shade, they insulate and protect various forest species.

In many cases, large diameter logs which are the result of felling breakage during logging are removed and then much smaller diameter logs are left on the unit to meet CWD requirements. Large diameter log sections often possess desirable CWD characteristics such as having more heartwood than smaller pieces. Yet, under the S&Gs, these pieces would not "count" because they are less than 16/20 feet long. Based on field examination, some biologists recommend the retention of these large diameter, shorter length logs. If these segments provide the desired CWD form and function despite the fact that their length is shorter than the specified minimum, they may be counted towards the linear requirement when:

- the large end diameters are greater than 30 inches and log length is greater than 10 feet;
- log diameters are in excess of 20 inches and volume is in excess of 40 cubic feet; (see attached table)
- they are the largest material available for that site.

4. QUESTION: When adequate amounts of pre-logging CWD are lacking, is it okay to provide standing green trees versus immediately felling trees during the regeneration harvest to meet the decay class 1 and 2 log specific measures, at least in the short term?

DISCUSSION: The standard is "[m]anage to provide a renewable supply of large down logs well distributed across the matrix landscape in a manner that meets the needs of species and provides for ecological functions." It is also recognized that "scattered green trees will provide a future supply of down woody material" The specific measures are to provide a supply of decay class 1 and 2 logs at the time of regeneration (and partial) harvest.

It is essential that at the time of regeneration harvest (and partial harvest) provisions be in place to ensure the supply of adequate amounts of CWD. In most cases, the required CWD amounts should be either reserved existing CWD or retained felled logs. (The original memorandum contained a special provision to be used for sales where the purchaser would "select" CWD to be left.) The strategy for CWD should be clearly documented during the planning process.

Experience suggests when tree sizes, disturbance history, and regeneration-harvest stand scheduling does not provide adequate down woody debris, the deficiency, including total absence, of decay class 1 and 2 logs could be corrected by marking additional standing trees and leaving them standing for a period following harvest. This could be accomplished by augmenting the Bureau of Land Management's scattered green tree retention (C-41) requirements. The additional trees would initially be left standing.

If the S&Gs require that 6-8 green trees per acre be retained, prescriptions would require that additional green trees be marked for retention and protection during sale preparation. Adequate potential trees would be retained whether these trees are to be felled or left as green trees for future down woody debris. By reserving all or a portion of decay class 1 and 2 logs, and additional standing trees as described above to correct any deficit, new contract language would not be needed. Operationally, some reserved green trees will be knocked down or felled during the course of logging operations.

Four scenarios have been proposed and recommended to provide the decay class 1 and 2 material by utilizing standing CWD trees:

Scenario 1. Blowdown commonly occurs and wind normally fells retention trees, providing both snags and down CWD immediately following regeneration harvest. After two winter seasons, wind-firm trees may still be standing; top snap occurs providing both snags and CWD; and blowdowns include total tree length, often with the root wad attached. A third year assessment would monitor for CWD and determine if the need exists to fell trees to meet the required linear feet.

Scenario 2. In small diameter regeneration harvest stands, the largest sized green trees are selected as CWD trees and felled following harvest. The alternative is to allow these trees to remain standing and potentially to grow into larger sized diameter CWD substrate after a reasonable period of time. The treatment is similar to partial harvest or commercially thinned units (see Question 5). To date, green tree CWD retention prescriptions have included some or all of the following elements:

- retain the largest sized diameter trees for required green leave trees;
- immediately post-harvest, ensure that enough logs are on the ground to meet one-half the CWD requirement;
- designate additional standing green trees to grow larger diameter trees;
- CWD green trees would be left standing for a period of time, 5-15 years, until they attained the desired larger size or succumbed to natural mortality. The necessary window to grow and provide the specified amount of CWD could be as long as 30 years.

Scenario 3. The strategy is to meet the decay class 1 and 2 log level required post-harvest immediately following logging or the site preparation treatment period. This strategy assumes that an adequate number of reserve trees are retained to meet the requirement. Upon completion of harvest, the existing linear feet of decay class 1 and 2 logs for each sale unit are tallied; and then the reserve trees are felled to meet the 120/240 linear foot requirement. Knockdowns, trees felled to alleviate a logging concern, and blowdowns are counted toward the total linear feet so long as they meet the decay class, diameter, and length requirements. The minimum amount of CWD linear feet are ensured, and excess trees continue to grow.

Scenario 4. Provide the full requirement of CWD logs in reserve trees. There is no need to measure linear feet since the decay class 1 and 2 requirements will be met from the standing, reserved trees. Accept whatever linear feet of decay class 1 and 2 logs is present on the unit post-harvest. It may range from zero to several hundred linear feet. The management action will be to allow natural forces (primarily, windthrow) to provide infusions of trees into CWD decay classes 1 and 2 over time from the population of marked retention trees and snag replacement trees. The option remains to revisit the site over time to monitor decay class 1 and 2 conditions and consider whether elective felling of selected retention trees is warranted. Note that any trees marked as replacement trees to correct snag deficiencies in the short term (three decades) may not count toward the standing retention tree requirements and may not be felled to account for the decay class 1 and 2 logs.

5. **QUESTION:** "In areas of partial harvest the same basic guidelines are to be applied, but they should be modified to reflect the timing [of] stand development cycles where partial harvesting is practiced" (S&G C-40, Part B). Does this mean we should be felling trees to provide CWD in selection and commercial thinning areas?

DISCUSSION: An accumulation of CWD should be designed into partial harvest prescriptions to provide a natural or biologically desired condition. The timing of stand development cycles providing snags and subsequent CWD from natural suppression and overstocking mortality should be accounted for, the desired conditions estimated, and then the advantages of treatment to improve habitat conditions beyond natural conditions should be assessed. The amounts of CWD should be specifically provided, including felling trees, to meet the desired conditions for late-successional forest related species. CWD trees are not normally required to be felled during harvest, especially trees with broken tops, advanced decay, or other deformities contributing habitat structural features. Leaving naturally dense clumps around snags to provide suppression mortality, scattering "structural" green trees, and allowing individual trees to grow into larger sized CWD materials should be considered in partial harvest plans. Leaving green trees and felling to provide a source for CWD should be part of the partial harvest prescription. The intent is to provide a source of "coarse woody debris well distributed across the landscape in a manner which meets the needs of species and provides for ecological functions."

Appendix Working Definitions

Coarse Woody Debris (CWD):

The portion of a tree that has fallen or been cut and left in the woods. Usually refers to pieces at least 20 inches in diameter (ROD Glossary F-4).

Coarse Woody Debris (CWD) or Down Woody Debris (DWD):

Any large piece of woody material having a diameter greater than 10 cm (4 inches) and a length greater than 1.0 meter (39 inches)¹. Fifteen to twenty percent ground cover of DWD or 4.5-10 tons of fresh DWD would be adequate after timber harvesting for optimal amounts of small mammal habitat and organic matter².

Desired Condition (DC):

Structural characteristics of late-successional forest vary with vegetation type, disturbance regime, and developmental stage. The desired condition also varies whether the target is a "natural" desired condition or a "biological" desired condition.

Historic Ecological Conditions (HEC):

This term is used to describe a set of ecological conditions that were likely present prior to European influence on the landscape. One of the assumptions was that during this time period natural processes and functions were occurring under inherent disturbance regimes, and thus these represent sustainable conditions. A description of these conditions is usually synonymous with the natural or historic range of variability and focuses on maintaining ecosystem processes and functions, not necessarily the viability of a particular species.

Species-Specific Biological Conditions (SBC):

This term is used to describe a set of biological conditions specific to the viability of a particular species. In particular, this term was used to describe habitat conditions for the northern spotted owl or other late-successional/old-growth forest-related species that may address short-term (up to 50 years) viability concerns. These habitat conditions are not necessarily the DEC and may not be sustainable in the long term (greater than 50 years) due to a variety of potential disturbances.

Desired Future Conditions (DFC):

This term is used to describe the interaction between HEC, SBC, and any other social issues that may result in deviation from the HEC. For example, the HEC is described for a particular vegetation type and due to the viability concern for northern spotted owl or other late-successional/old-growth forest-related species, the SBC requires a deviation from the HEC. By overlaying the two conditions, the DFC for that vegetation type is then described. In cases where there were no overriding viability issues with any species, the HEC was synonymous with the DFC.

¹ Society of American Foresters. *Forest Ecology Working Group Terms*. 1996.

² Carey, A. and M. Johnson: Small Mammals in Managed, Naturally Young and Old-Growth Forests. *Ecological Application* 5(2): 336-351, 1995; Nakamura, F. And F. Swanson: Distribution of Coarse Woody Debris in a Mountain Stream, Western Cascades Range, Oregon. *Canadian Journal of Forestry Research* 24: 2395-2403, 1994.

TABLE 1
VOLUME PER LOG SEGMENT
TAPER PER 16 FEET

Diameter Large End (inches)	Segment Length (feet)								
	20	18	16	14	12	10	8	6	4
20	38.5	35.1	31.6	28.0	24.3	20.5	16.6	12.6	8.5
22	47.1	42.9	38.6	34.1	29.6	24.9	20.2	15.3	10.3
24	56.6	51.5	46.3	40.9	35.4	29.8	24.1	18.1	12.3
26	67.0	60.9	54.6	48.3	41.8	35.1	28.4	21.5	14.5
28	78.2	71.0	63.7	56.2	48.6	40.9	33.0	25.0	16.8
30	90.3	82.0	73.5	64.8	56.0	47.1	38.0	28.7	19.3
32	103.3	93.7	84.0	74.0	64.0	53.7	43.3	32.7	22.0
34	117.2	106.2	95.1	83.8	72.4	60.8	49.0	37.0	24.9
36	131.9	119.5	107.0	94.3	81.4	68.3	55.0	41.5	27.9
38	147.5	133.6	119.6	105.3	90.9	76.2	61.4	46.3	31.1
40	164.0	148.5	132.8	116.9	100.9	84.6	68.1	51.4	34.5
42	181.3	164.2	146.8	129.2	111.4	93.4	75.2	56.7	38.0
44	199.5	180.6	161.4	142.1	122.5	102.6	82.6	62.3	41.8
46	218.6	197.8	176.8	155.5	134.0	112.3	90.3	68.1	45.7
48	238.6	215.8	192.9	169.6	146.2	122.4	98.5	74.2	49.7
50	259.4	234.6	209.6	184.3	158.8	133.0	106.9	80.6	54.0
52	281.1	254.2	227.1	199.6	171.9	144.0	115.7	87.2	58.4
54	303.7	274.6	245.2	215.6	185.6	155.4	124.9	94.1	63.0
56	327.2	295.8	264.1	232.1	199.8	167.3	134.4	101.3	67.8
58	351.5	317.7	283.6	249.2	214.6	179.6	144.3	108.7	72.8
60	376.7	340.4	303.9	267.0	229.8	192.3	154.5	116.3	77.9

E AVAILABLE

225

APPENDIX F

Roads of Concern

Objective: To reduce road density, compacted area, peak flows, sedimentation, and/or roads adjacent to or in Riparian Reserves.

Recommendation: Decommission the following roads.

Road Numbers

39-3-8.0 Segment B

39-3-26.1

39-3-27.0 Segment C

39-3-27.1 Segment B

Unnumbered jeep road in T.39S., R.3W., Section 35

39-3-29.0

39-3-30.3

39-3-30.5

Unnumbered jeep road in T.39S., R.4W., Sections 11 & 12

39-4-13.0

39-4-13.1

39-4-22.1

39-4-22.3

39-4-22.4

39-4-22.5

39-4-23.1

39-4-23.2

39-4-26.0

39-4-24.0 (the last 1/3 mile only)

Two numbered jeep roads in T.39S., R.4W., Section 25

Two numbered jeep roads in T.39S., R.4W., Sections 23, 26, 27 & 28

Objective: To reduce wildlife disturbance.

Recommendation: Block the following roads.

Road Numbers

39-4-12.0

Unnumbered jeep road in T.39S., R.4W., Sections 11 & 12

39-4-28

39-4-23.2

39-4-24.0

39-3-19.2

39-3-19.1

39-3-30.8

Road Numbers

38-3-30.1

38-3-30.2

38-3-30.6

38-3-30.4

END

10-28-98